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Dimension - version 7.x.x

CE 0470

4D and Multi-plane Imaging

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Operating Documentation

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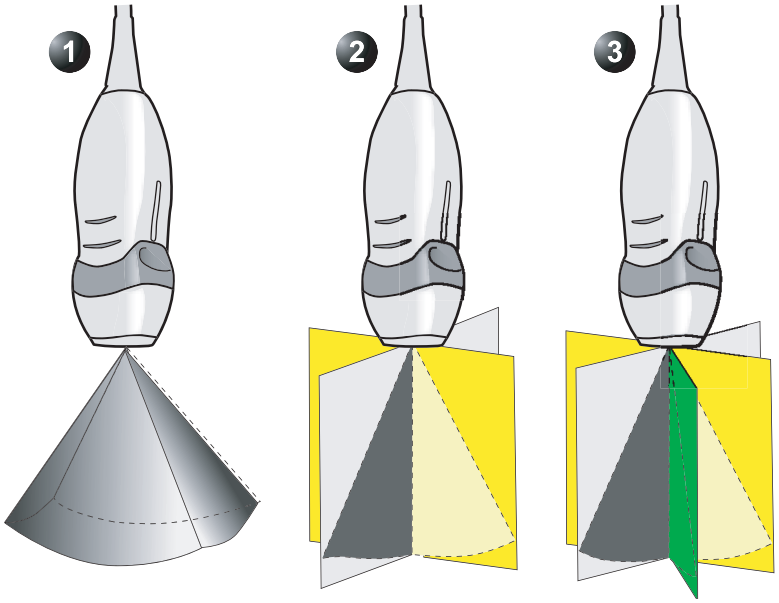
Introduction

This user manual describes the 4D and Multi-plane Imaging applications for the Vivid 7 Dimension and EchoPAC PC Dimension.

The 2D matrix probe 3V enables real time volume rendering, simultaneous bi-plane or tri-plane data acquisition (multi-plane acquisition).



1. Real time Volume acquisition (4D imaging)
2. Real time Bi-plane acquisition
3. Real time Tri-plane acquisition

4D imaging

4D imaging enables real time acquisition and rendering of volume ultrasound data. Free rotation of the 3-dimensional image combined with the zoom function and 4D image optimization controls enhance spatial understanding of the anatomical structure and function of the heart.

4D imaging is available in combination with B-Mode only.

Multi-plane Imaging

Multi-plane imaging displays two (Bi-plane) or three (Tri-plane) rotated scan planes acquired simultaneously. Free rotation, tilting (in Bi-plane) of the scan planes and zoom enable the investigation of anatomical structures from different angles.

Multi-plane imaging is available from B-Mode, Color flow mode and TVI related modes.

If not otherwise specified, the term multi-plane means either Bi-plane or Tri-plane.

Measurement and analysis

All cardiac measurements available in B mode are also available in 4D and Multi-plane.

The 4D and Multi-plane modes enable the creation of a left ventricular volume reconstruction based on contours drawn from three cross sections at both end-systole and end-diastole with calculation of end-systolic and end-diastolic volumes and ejection fraction.

Multi-plane stress echo

Combined with specially designed Stress echo protocols, Multi-plane mode enables faster stress tests as several views can be acquired simultaneously.

Remark concerning the 3V probe

The 3V probe temperature will increase during extensive use, due to heating from the probe electronics. If the probe reaches its temperature limit, this will be detected by the system and scanning will stop. Currently, this limit is set to 42.3 degrees Celsius, which complies with regulatory instructions relating to patient comfort and safety. This is reported with a dialog box and the user has to wait until the temperature is below acceptable limits before scanning can continue. This does not in any way indicate probe malfunction. The user has to unfreeze to start scanning again.

In order to reduce the chance for full freeze due to heating, the system will reduce power slightly in a temperature interval just

below the full freeze limit. Changes to the power level are reported in the status bar as *Setting power level down* and *Setting power level up*.

The recommended use of this probe for live 4D and full volume 4D scanning is to enter full freeze whenever the probe is not used for imaging. For other modalities no special actions are required.

Important

Read and understand all instructions in the Vivid 7 and EchoPAC PC User manuals before attempting to use the devices.

Conventions used in this manual

Keys and button, on the control panel or alphanumeric keyboard are indicated by over and underlined text (ex. **2D** refers to the 2D mode key)

Bold type, describes button names on the screen.

Italic type: describes program windows, screens and dialogue boxes.

Icons, highlight safety issues as follow:

DANGER

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:

- Severe or fatal personal injury
- Substantial property damage

WARNING

Indicates that a specific hazard exists that, given inappropriate conditions or actions, will cause:

- Severe personal injury
- Substantial property damage

CAUTION

Indicates that a potential hazard may exist that, given inappropriate conditions or actions, can cause:

- Minor injury
- Property damage

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Introduction

The 3V probe enables real time acquisition of volume ultrasound data. Free rotation of the three-dimensional image combined with zooming and 4D image optimization controls enhance spatial understanding of the anatomical structure and function of the heart.

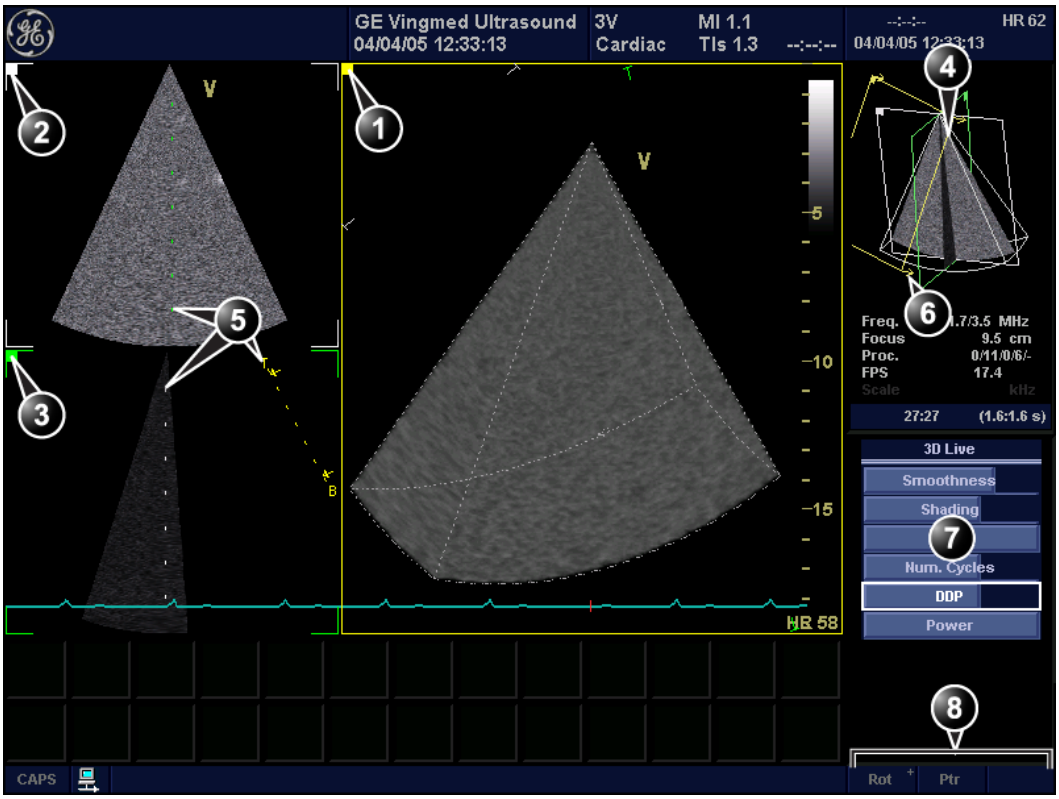
Two display modes are available, Volume rendering mode for three dimensional scanning and Slice mode for measurements and volume reconstruction purpose.

4D imaging is available from B mode only.

4D mode overview - Vivid 7

Volume rendering mode screen

The Volume rendering mode displays a volume rendering and 2D images from two perpendicular cut-planes.

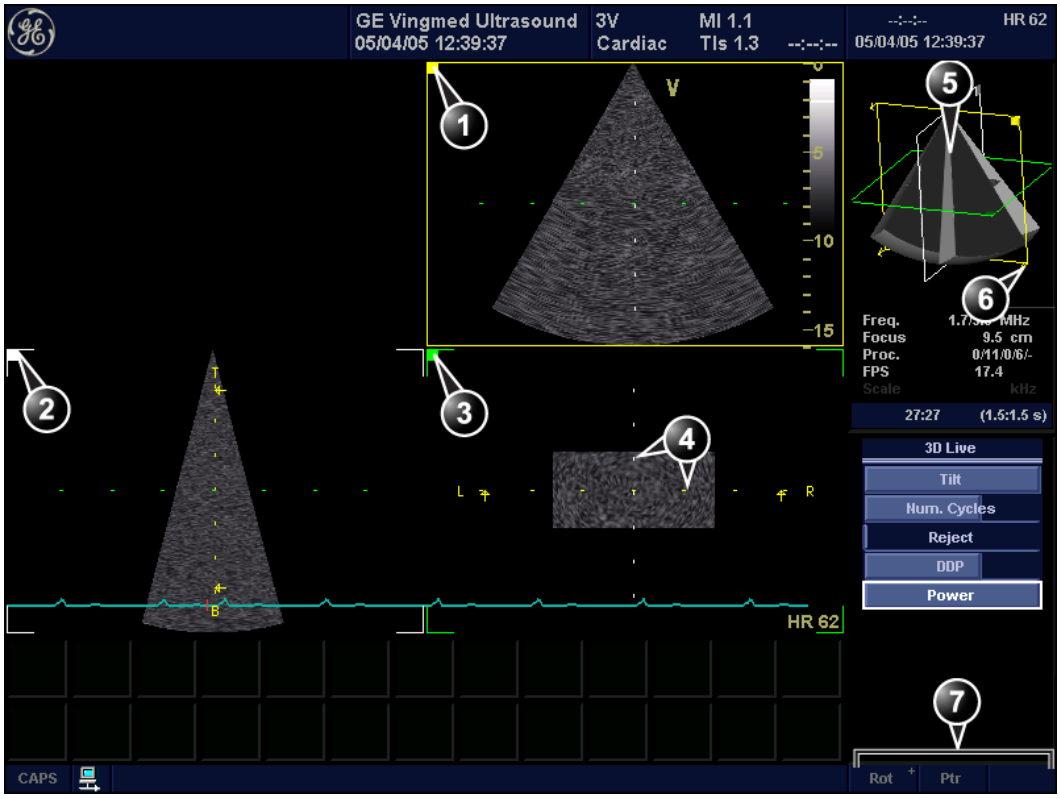


1. **Volume rendering display from cut-plane 1 (yellow). The volume rendering may be adjusted by rotating and translating the cut-plane 1.**
2. **Cut-plane 2 (white): 2D image in the azimuth plane.**
3. **Cut-plane 3 (green): 2D image in the elevation plane.**
4. **Orientation window: displays a three-dimensional model with cut-planes position and orientation.**
5. **Color coded cut-plane markers indicate the other cut-planes position relative to the displayed cut-plane.**
6. **View direction marker.**
7. **Soft menu controls (see page 16)**
8. **Trackball functions (see page 17)**

Figure 1-1: The 4D screen (Volume rendering)

Slice mode screen

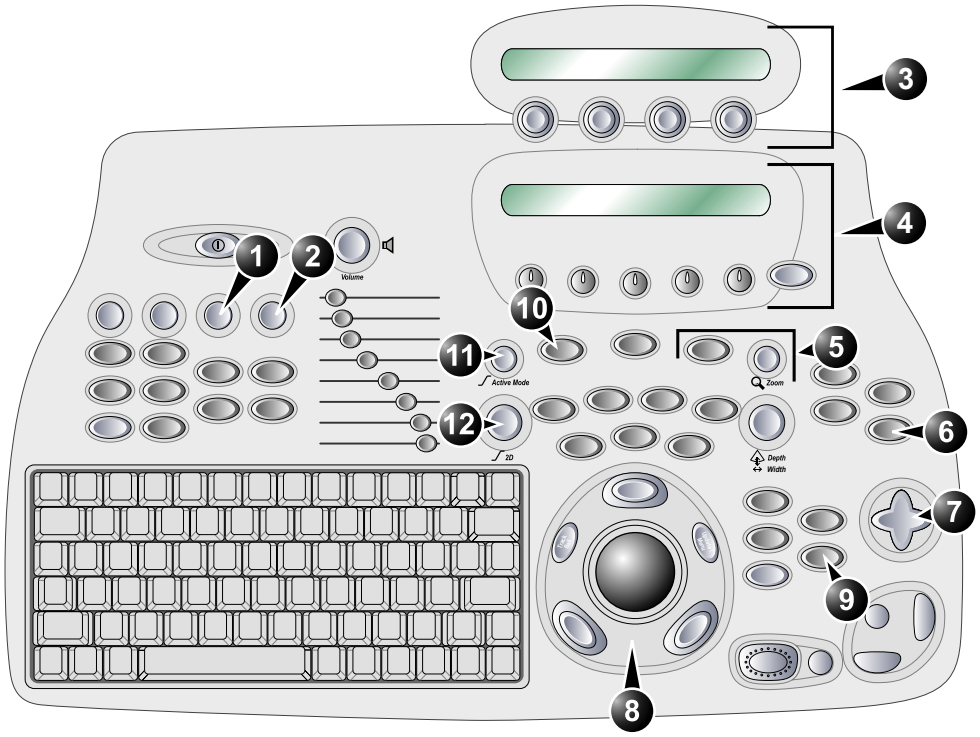
The Slice mode displays three cut-planes. The cut-planes can be rotated and translated independently of each other. This mode is use to perform measurements and volume reconstruction based on contour traces done on several cut-planes.



1. **Cut-plane 1 (yellow)**
2. **Cut-plane 2 (white)**
3. **Cut-plane 3 (green)**
4. **Color coded cut-plane markers indicate the position of the other cut-planes relative to the displayed cut-plane.**
5. **Orientation window: displays a three-dimensional model with cut-planes position.**
6. **View direction marker.**
7. **Trackball functions (see page 17)**

Figure 1-2: The 4D screen (Slice mode)

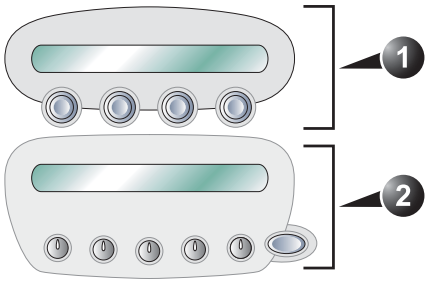
4D mode controls



1. **4D key**
2. **Multiplane key (see page 65)**
3. **Assigned 4D rotaries: see next page.**
4. **Assigned 4D keys: see next page.**
5. **Zoom/HR Zoom (see page 20)**
6. **Layout (see page 19): toggles the display between:**
   - **Multi screen with volume/slice**
   - **Single screen volume/slice**
7. **Soft menu**
8. **Trackball (see page 17)**
   - **Rotate/translate volume rendering or selected cut-plane (Slice mode)**
   - **Scroll through the cineloop**
9. **Clear: resets the orientation to default positions.**
10. **Angle: predefined orientations optimized for volume rendering.**
11. **4D Gain**
12. **2D Gain**

Figure 1-3: The 4D controls on the control panel

Assigned rotaries and keys



Volume rendering assigned controls

1. **Assigned rotaries**
   - **Width**
   - **Frequency**
   - **Focus position**
   - **Volume size**

   MORE menu
   - **Translate R**

2. **Assigned keys**
   - **Slice R**
   - **Front/Back**
   - **Crop (in Freeze only) R**
   - **Box (in Freeze only) R**
   - **Cineloop (in Freeze only) R**
   - **Full volume**
   - **4D Colorize R**
   - **9 Slice (in Full volume Freeze only) R**

   MORE menu
   - **Up/Down R**
   - **Flip R**
   - **Orientation window R**
   - **Cine rotate (in Freeze only) R**

Slice mode assigned controls

1. **Assigned rotaries**
   - **Width**
   - **Rotate R**
   - **Translate (in Freeze only) R**
   - **Focus position**
   - **Volume size**

   MORE menu
   - **Frequency**

2. **Assigned keys**
   - **Slice exit R**
   - **Reference plane R**
   - **Cineloop (in Freeze only) R**

   MORE menu
   - **Up/Down R**
   - **Orientation window R**

Controls marked with **R** are also available in cine replay.

Figure 1-4: Volume rendering and Slice mode assigned controls

4D mode assigned controls

This section describes only the 4D mode controls. The scanning mode controls are described in the system User manual.

Width

(Volume rendering and Slice mode, Live)

Controls both elevation and azimuth widths, an increase of the elevation width results in a decrease of the azimuth width.

Volume size

(Volume rendering and Slice mode, Live)

Controls the size of the volume. Adjusting the volume size may affect the volume rate.

Rotate

(Slice mode, Live and Replay)

Rotate the selected cut-plane around the z-axis (see Figure 1-5).

1. **Rotate control**

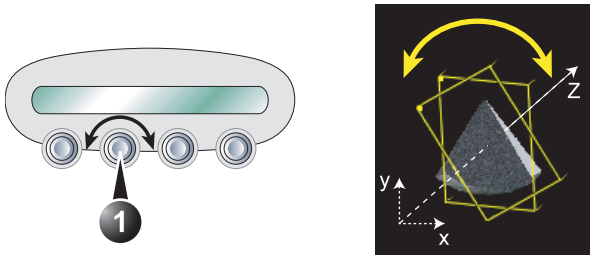


Figure 1-5: Cut-plane rotation around the z-axis

Slice/Slice exit

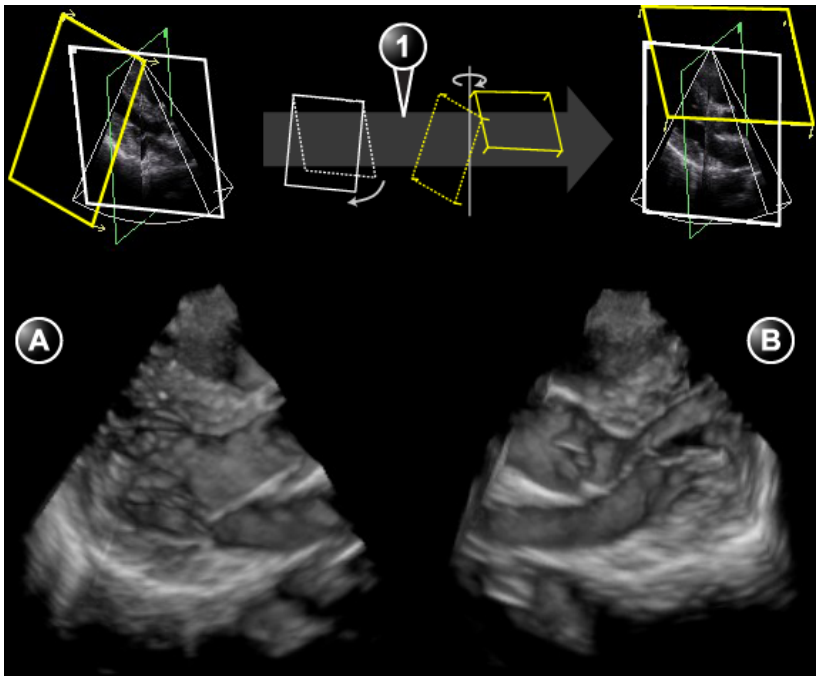
(Volume rendering and Slice mode, Live and Replay)

Toggles the display between Volume rendering (Figure 1-1) and Slice mode (Figure 1-2).

Front/Back

(Volume rendering, Live and Replay)

Tilts the volume in the elevation direction and rotates the view position in one operation. **FRONT/BACK** enables volume rendering display from different angles (Figure 1-6).



1. Front/Back: Volume tilt and View position rotation

A. Volume tilted to the left, view position looking towards the anterior wall.

B. Volume tilted to the right, view position looking towards the inferior wall.

Figure 1-6: Front/Back control on a PLAX volume

Reference plane

(Slice mode, Live and Replay)

Toggles the cut-plane selection between cut-plane 1, 2 or 3.

Crop (Free cropping)

(Volume rendering, Freeze and Replay)

Removes all data up front of the active cut-plane. Cropping can be applied on several parts of the volume by rotating/translating the active cut-plane (see page 26).

Box (Box cropping)

(Volume rendering, Freeze and Replay)

Removes all data around a user-adjustable box (see page 27).

Full volume

(Volume rendering, Live)

Activates the ECG triggered sub-volume acquisition. This technique enables the acquisition of a larger volume without compromising the resolution, by combining several sub-volumes acquired over two to six heart cycles (see Figure 1-7). When acquisition is done for the number of heart cycles set, the process is repeated replacing the oldest sub-volumes.

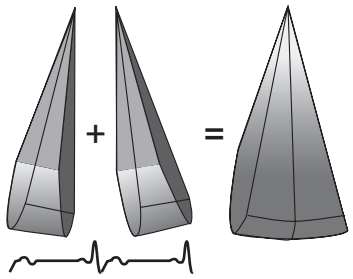


Figure 1-7: ECG triggered volume acquisition (two heart cycles)

4D Colorize

(Volume rendering, Live and Replay)

Adjusts the volume rendering color from a color map menu.

Depth encoded color maps

From this menu the user can also select a depth encoded color map. These color maps use colors to improve the perception of depth. Selecting the bronze/blue color map will display structures that are close to the view plane with a bronze color. Structures that are farther behind will be colored with a gray

color, while the structures that are farthest behind will be colored in blue. Very bright colors are almost white, independent of the depth.

Stereo vision

4D Stereo vision is a display technique that enhances the perception of depth in 3D renderings. This is achieved by mixing two different volume renderings with slightly separated viewing angles and presenting them separately to the user's left and right eyes. This feature requires the use of anaglyph stereo glasses (glasses with one red and one cyan lens).

Normally you should be able to see the stereoscopic effect after a few seconds. The effect may gradually improve after a while. If you are already wearing glasses or lenses you should not take them off, since the stereo effect then may be greatly reduced.

Note: Not all users may be able to perceive depth using stereoscopic display techniques.

Additional 4D mode assigned controls

The following controls are available after pressing **MORE**.

Up/Down

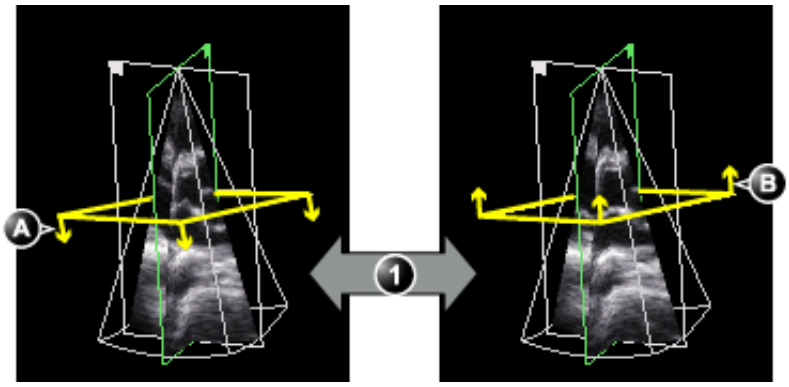
(Volume rendering and Slice mode, Live and Replay)

Flips the volume 180 degrees.

Flip

(Volume rendering, Live and Replay)

Flips the view position (Figure 1-8).



1. Flip control

A. View position looking downward

B. View position looking upward

Figure 1-8: Flip control

Orientation window

(Volume rendering and Slice mode, Live and Replay)

Shows/hides the *Orientation window*.

Cine rotate

(Volume rendering, Replay)

Rotates back and forth the volume rendering.

Soft menu controls

Soft menu controls are related to image quality adjustment. These controls are accessed using the 4-way rocker on the control panel. Only the 4D controls are described in this section, refer to the system user manual for general imaging controls.

Smoothness

(Volume rendering, Live and Replay)

Affects continuity of structures and image noise. Too much smoothness will blur the image, too little will leave too much noise.

Shading

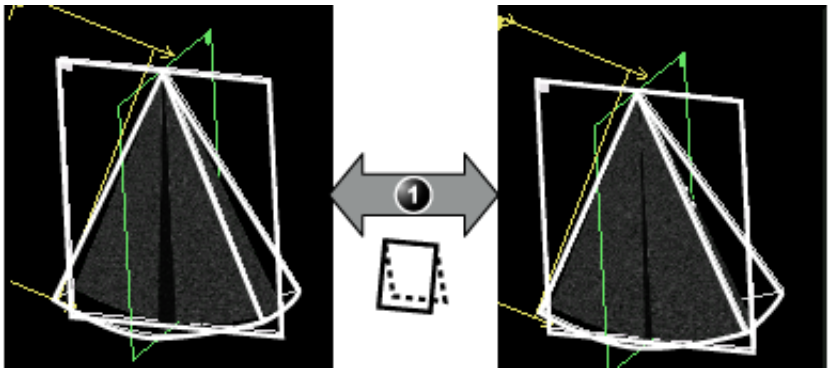
(Volume rendering, Live and Replay)

Adjusts the shading effect on the image. Shading may improve three dimensional perception.

Tilt

(Volume rendering, Live)

Tilts the volume in the elevation direction.



1. Tilt control: volume tilting in the elevation direction

Figure 1-9: Tilt control

Number of Cycles

(Volume rendering, Live, Full volume acquisition)

Controls the number of cycles the ECG triggered full volume acquisition is based on. Select between two, three, four or six cycles. Four cycles is default setting.

DDP (Data Dependent Processing)

(Volume rendering, Live)

Performs temporal processing which reduces random noise without affecting the motion of significant tissue structures.

UD Clarity

(Volume rendering, Freeze and Replay)

Enables the user to create a personalized appearance of the tissue rendering by reducing noise and enhancing boundaries between different structures. Adjustment toward the left creates a smoother image. Adjustment toward the right creates a crisper image.

Volume optimize

(Volume rendering, Live and Replay)

Optimizes the volume rendering by adjusting several display controls simultaneously (e.g Shading, Smoothness... etc.).

Gamma

Adjusts the brightness of midtone values. A higher gamma value produces an overall darker image, a lower gamma value a lighter image.

Trackball controls

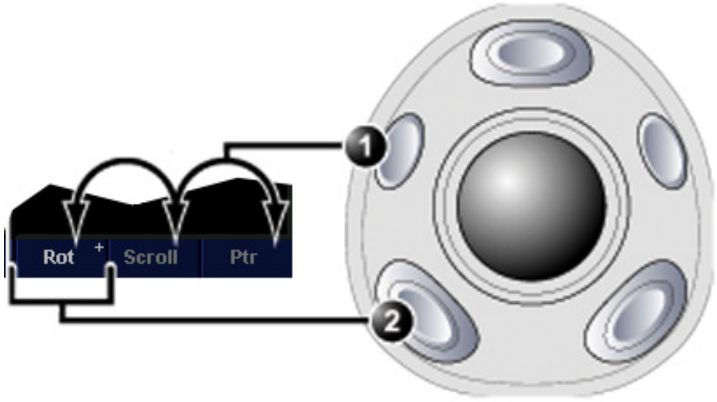
The trackball has multiple functions. The trackball functions are organized in several functional groups as shown in the table below.

The function selected is displayed in the lower right corner of the screen (Figure 1-10).

- Press **SELECT** to toggle between the trackball functions within the active functional group. Groups with several

functions are marked with a + symbol.

- Press **TRACKBALL** to toggle between the functional groups.



1. **Trackball key: toggles between trackball functional groups.**
2. **Select key: toggles between the functions within the active group. Groups with several functions are marked with a + symbol.**

Figure 1-10: The Trackball area

Orientation controls group	
Function	**Description**
Press **SELECT** to toggle between the controls.	
Rotate	Rotates the volume rendering (see page 25).
Translate	Translates the volume rendering (see page 25).

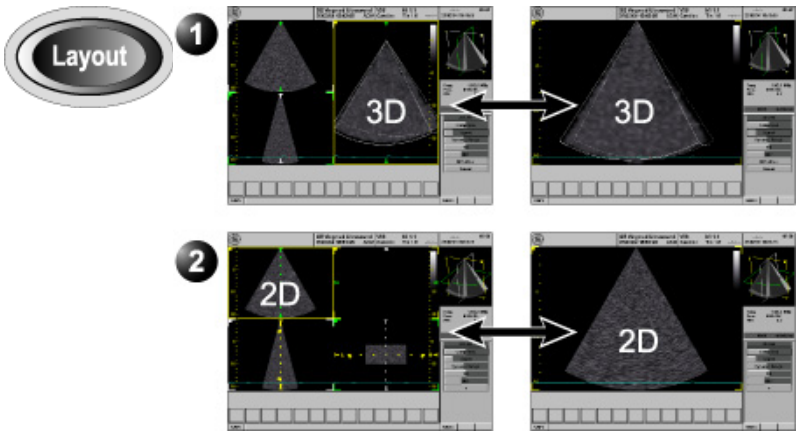
Cineloop control group	
Function	**Description**
Scroll	Scrolls through a cineloop.

Display controls

Layout key on the front panel

Toggles the display between multi-screen and single-screen.

- Multi-screen:
  - In Volume rendering: displays a volume rendering and 2D images from two perpendicular cut-planes.
  - In Slice mode: displays 2D images from three cut-planes with the selected cut-plane in the main window.
- Single-screen:
  - In Volume rendering: displays the volume rendering.
  - In Slice mode: display the 2D image of the selected cut-plane.



1. **Display options for Volume rendering**
2. **Display options for Slice mode**

Figure 1-11: 4D mode display options

4D Gain (Active Gain rotary)

Affects the image “depth” or transparency. Too much 4D Gain applied will take away structures, too little will leave opaque “Gray clouds” in the ventricle.

Zoom

Display zoom

Activated and adjusted by rotating the **ZOOM** rotary (). The rectangular shape of the zoomed area is displayed in the *Orientation window*.

High Resolution (HR) zoom

HR zoom concentrates the image processing to a magnified, user selectable area in the image, resulting in a higher volume rate in the selected image area.

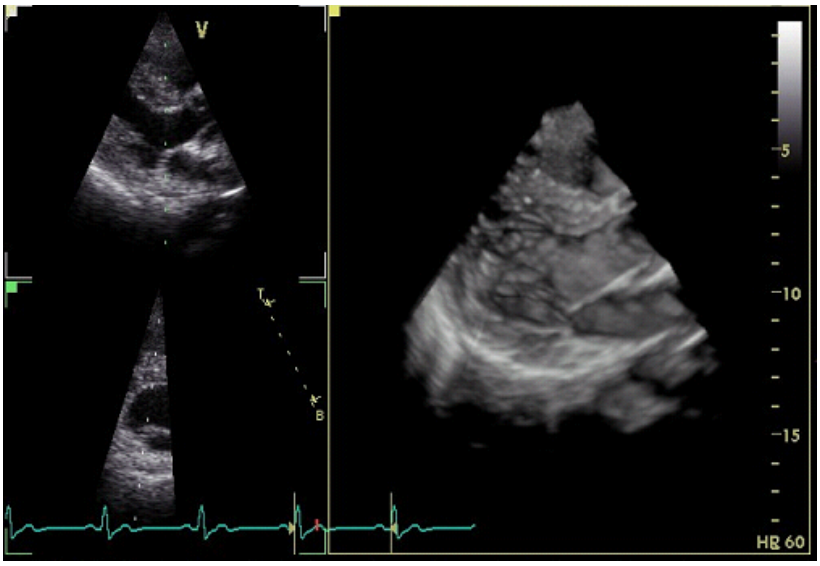
To be able to use the HR zoom in 4D imaging the HR zoom function must be activated in B mode before entering the 4D imaging mode.

Using 4D mode - Vivid 7

1. Select the 3V probe and cardiac application.
2. Create an examination.

Parasternal view acquisition

1. In 2D mode, acquire a PLAX view and optimize the image quality, using **DEPTH**, **GAIN**, **TGC**...etc.
2. Press **4D**.
3. Move the probe up or down so that the anterior wall is just inside the image in the lower left window in the *4D screen* (Figure 1-12).



Note: In this position the volume is tilted to the left and the view position is looking towards the anterior wall.

Figure 1-12: PLAX volume rendering

4. Adjust **4D Gain** to optimize the depth impression of the back wall.
5. To display a volume looking towards the inferior wall, press **FRONT/BACK**.
   The volume is tilted to the right and the view position is rotated 180 degrees.

6. Press **FREEZE**, **2D FREEZE** and rotate the volume to check the result.
7. Press **IMG. STORE**.

Apical view acquisition

1. In 2D mode, acquire a Apical view and optimize the image quality, using **DEPTH**, **GAIN**, **TGC**...etc.
2. Press **4D** and follow the same procedure as for the PLAX view (see page 21).
   Make sure to assess the image quality in the reference views and the volume rendering. Use **FRONT/BACK** to display the volume correctly.
3. Press **FREEZE**, **2D FREEZE** and rotate the volume to check the result.
4. Press **IMG. STORE**.

Full volume acquisition

Full volume acquisition is based on ECG triggering acquisition of sub-volumes. This technique enables the acquisition of a larger volume without compromising the resolution, by combining several sub-volumes acquired over two, three, four or six heart cycles (see Figure 1-7, page 13). When acquisition is done for the number of heart cycles set, the process is repeated replacing the oldest sub-volumes.

△
CAUTION

ECG triggering acquisition may by nature contain artifacts.

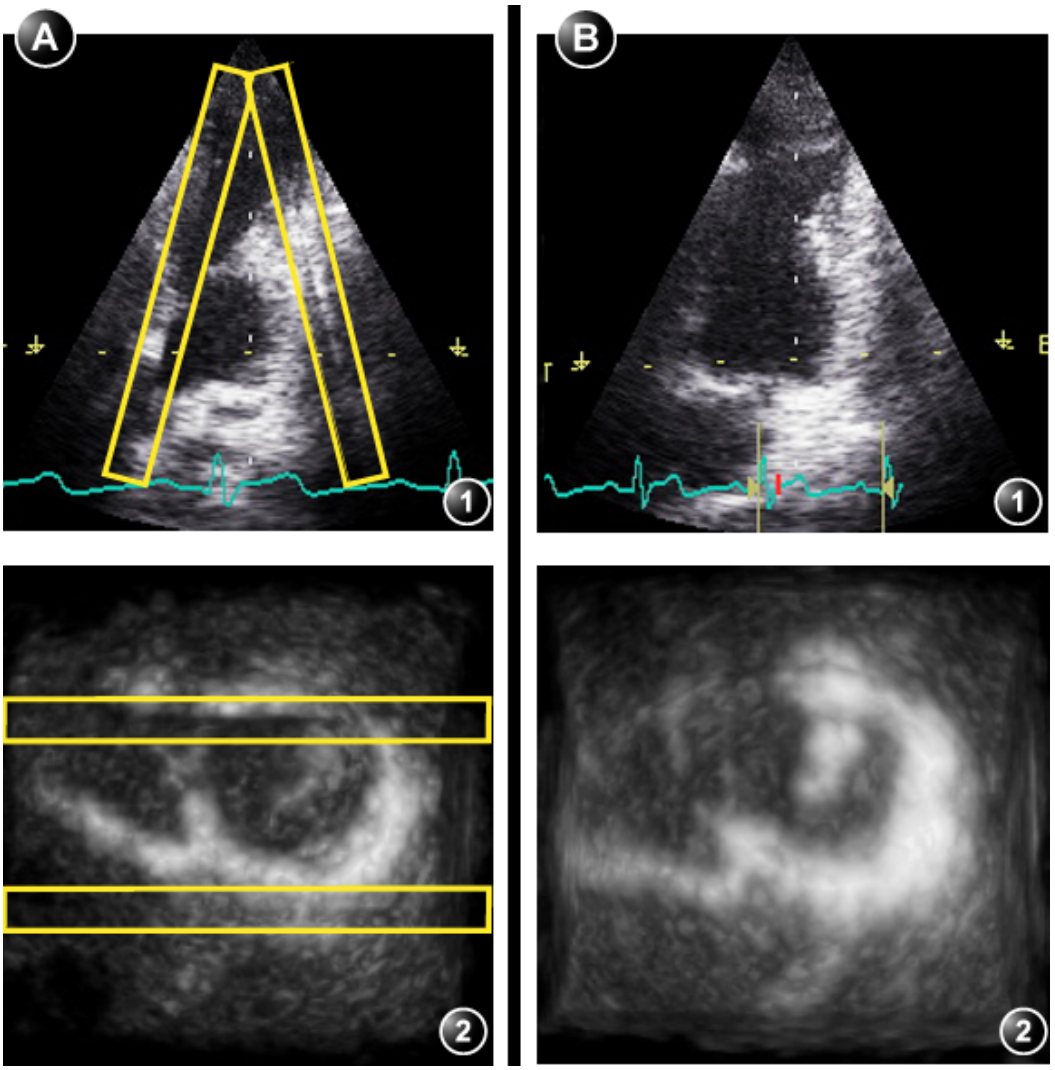
Artifacts may be caused by:

- ***Movements of the probe caused by the operator during acquisition.***
- ***Movements of the patient during acquisition.***
- ***Irregular heart rate during acquisition.***

To validate the acquisition, perform a visual inspection in both the volume rendering and the elevation plane. Stitching artifacts are shown as visible transitions between the sub-volumes (Figure 1-13)

To avoid spatial artifacts, make sure that the probe and the patient are not moving during the acquisition. The patient should, if possible hold his/her breath. The ECG trace should be stable.

1. Connect the ECG device and make sure to obtain a stable ECG trace.
2. In 2D mode, acquire an Apical view and optimize the image quality, using **DEPTH**, **GAIN**, **TGC**...etc.
3. Press **4D**.
4. Press **FULL VOLUME**.
   The Full volume acquisition is started.
5. You may adjust **ANGLE** to get different view. The default top/down view is best for stitching quality assessment.
6. Ask the patient to hold her/his breath at end expiration. Keep the probe steady and look for stitching artifacts in both the volume rendering and the elevation plane in the lower left window of the screen (Figure 1-13).
   Attention should be brought on stitching quality during acquisition rather than volume rendering quality.



A: Acquisition with stitching artifacts

1. **Elevation plane**
2. **Volume rendering**

B: Acquisition without stitching artifacts

1. **Elevation plane**
2. **Volume rendering**

Figure 1-13: Stitching quality assessment

When no artifacts are seen over a few heart cycles, press **FREEZE**.

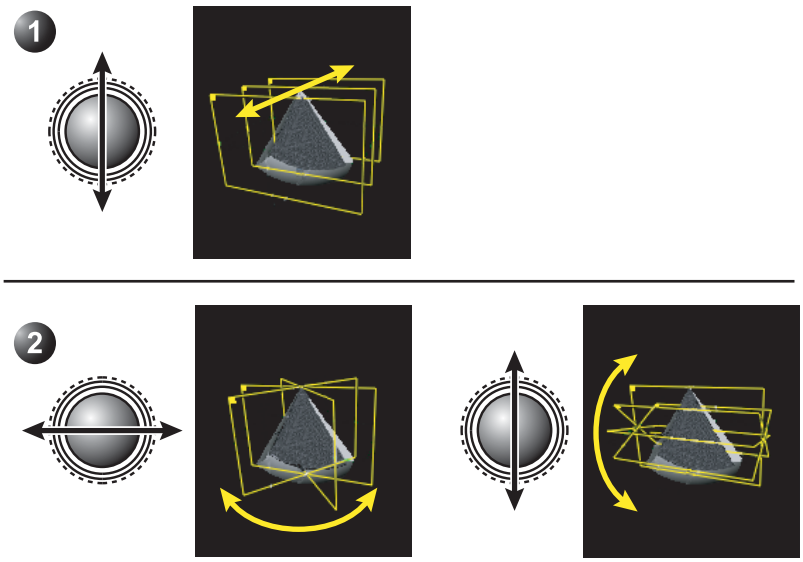
Note: it is recommended to acquire several heart cycles and use **SELECT CYCLE** to select the best one.

7. Once in Freeze, adjust **4D GAIN**. Rotate the volume to check the result and tress **IMG. STORE**.

Rotating/Translating the 4D image

Translation and rotation can be performed in either Volume rendering or Slice mode. Press **SLICE** to toggle between the two modes.

1. Move the trackball to rotate or translate the cut-plane according to the trackball function selected.
2. Press **SELECT** to toggle between **Rotate** and **Translate**. Move the trackball to apply the selected control (see Figure 1-14).
   The default position can be displayed again by pressing **CLEAR**.



1. **Select the trackball control “Translate” and use the trackball to translate the cut-plane.**
2. **Select the trackball control “Rotate” and use the trackball to rotate the cut-plane (all directions).**

Figure 1-14: Rotating/translating the 4D image

Zooming

1. Rotate the **ZOOM** knob clockwise on the control panel. The volume rendering is magnified. The frame of the Volume rendering cut-plane in the *Orientation window* is updated showing the magnified portion of the volume (Figure 1-15).

1. Zoomed area

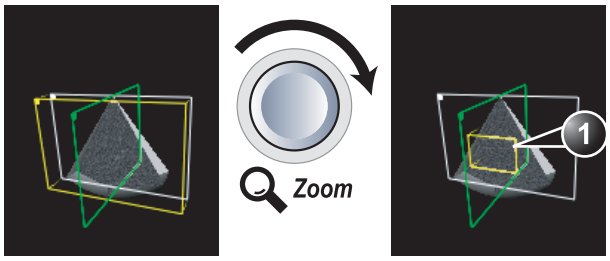


Figure 1-15: The Orientation window in zoom mode

Cropping

There are two cropping tools available: Free cropping tool and Box cropping tool.

The Free cropping tool removes all data up front of the active cut-plane. Cropping can be applied on several parts of the volume by rotating/translating the active cut-plane.

The Box cropping tool removes all data around a user-adjustable box.

It is not possible to use both cropping tools on the same acquisition.

Free cropping

The Free cropping tool is available in Volume rendering mode, when in Freeze or in Replay.

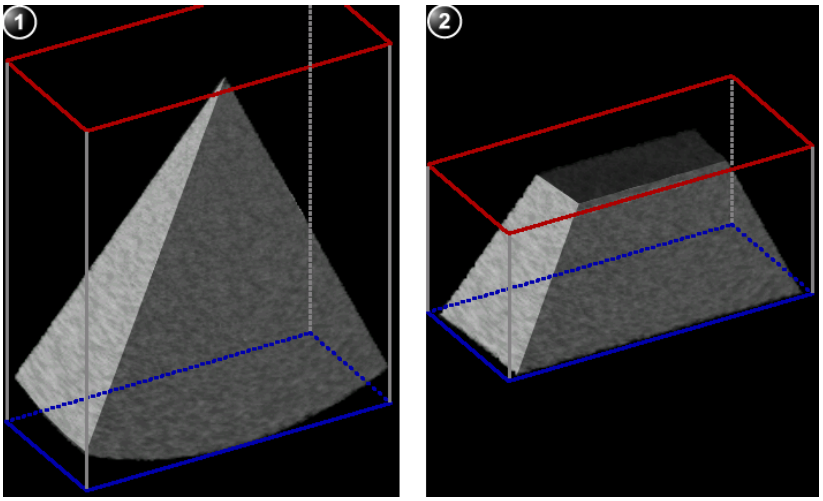
1. While in Volume rendering live mode, press **FREEZE**.
2. Press **CROP**.
   Note: Pressing **CROP** will remove any previous Box cropping operations.
3. Rotate and translate the active cut-plane.
   All data above the cut-plane will be removed when applying crop.

4. Press **SET** to apply crop.
   All data up front of the active cut-plane is removed.
5. Repeat steps 3 and 4 to remove other parts of the volume.
   Note: press **UNDO CROP** to undo the cropping actions stepwise.
   Press **REMOVE CROP** to undo all cropping actions in one operation.

Box cropping

The Box cropping tool is available in Volume rendering mode, when in Freeze or in Replay.

1. While in Volume rendering live mode, press **FREEZE**.
2. Press **BOX**.
   A box frame is displayed with two adjustable sides (highlighted as red and blue), see Figure 1-16.
   Note: Pressing **BOX** will remove any previous Free cropping operations.
3. Rotate the **RED** and **BLUE** assigned rotaries to adjust the corresponding sides around the structure of interest.
   All data outside the box is removed.
4. Rotate the **BOX SIDES** assigned rotary to select two other sides of the box.
5. Repeat steps 3 and 4 to adjust the selected sides of the box until the structure of interest is within the box.
   Note: press **RESET BOX** to undo the box adjustments.
6. Press **BOX EXIT** to apply and exit box cropping.



1. **Default cropping box with two active sides (red and blue). The other sides can be selected for adjustment**
2. **Cropped volume (from upper and lower sides)**

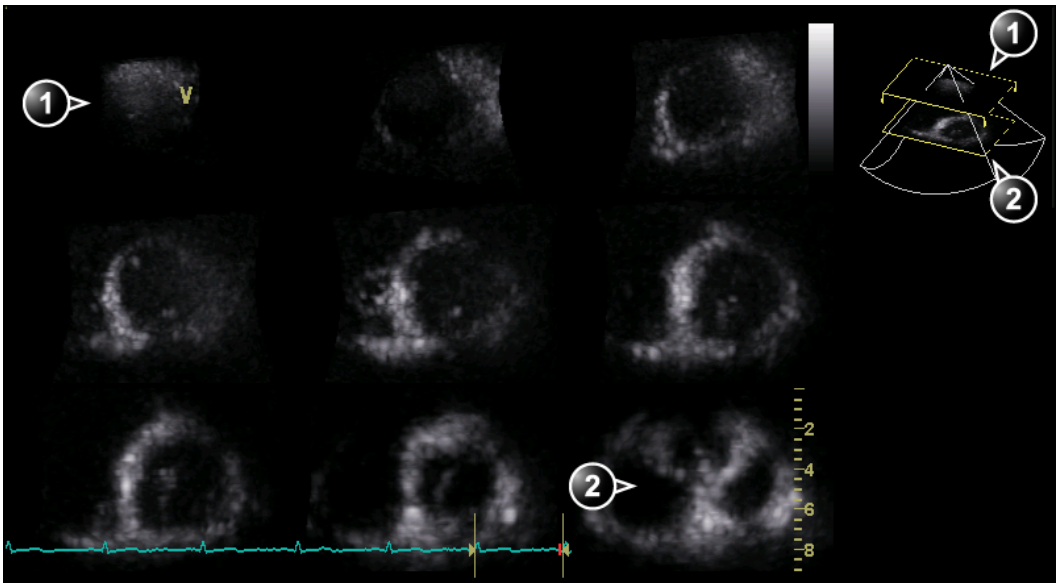
Figure 1-16: Box cropping

9 Slice

9 Slice enables simultaneous display of nine short axis views generated from an Apical full volume acquisition.

9 Slice is available only from a full volume acquisition when in Freeze.

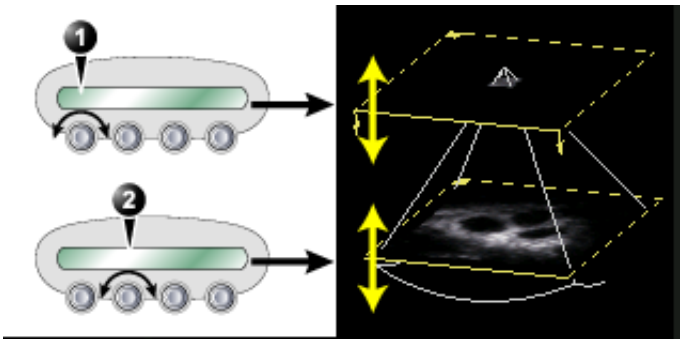
1. Acquire an apical Full volume view (see page 23).
2. Press **FREEZE**.
3. Press **9 SLICE**.
   The *9 Slice screen* is displayed showing nine short axis views (Figure 1-17). The slices are evenly distributed and maximized in size for best assessment.



1. **Upper slice**
2. **Lower slice**

Figure 1-17: 9 Slice screen

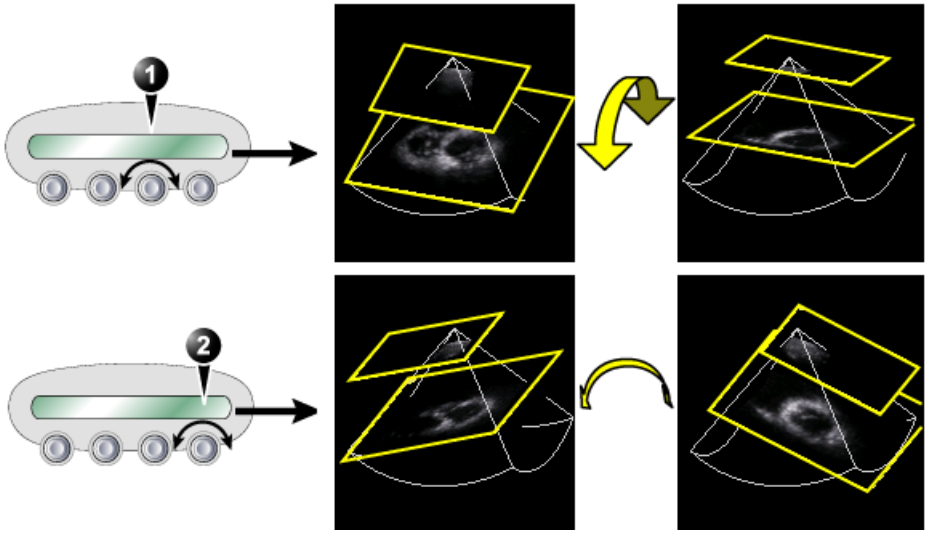
   If required, zoom in. All slices are zoomed in simultaneously.
4. The following adjustments can be done:
   - Adjust **TOP** and **BOTTOM** controls to change the slicing area (Figure 1-18).



1. **Top: upper slice adjustment**
2. **Bottom: lower slice adjustment**

Figure 1-18: Slice distribution adjustment

- Adjust the **AXIS 1** and **AXIS 2** controls to rotate the slices backward/forward and sideways (Figure 1-19), to align the slices with the anatomical structure.



1. **Axis 1: slice rotation backward/forward**
2. **Axis 2: slice rotation sideways**

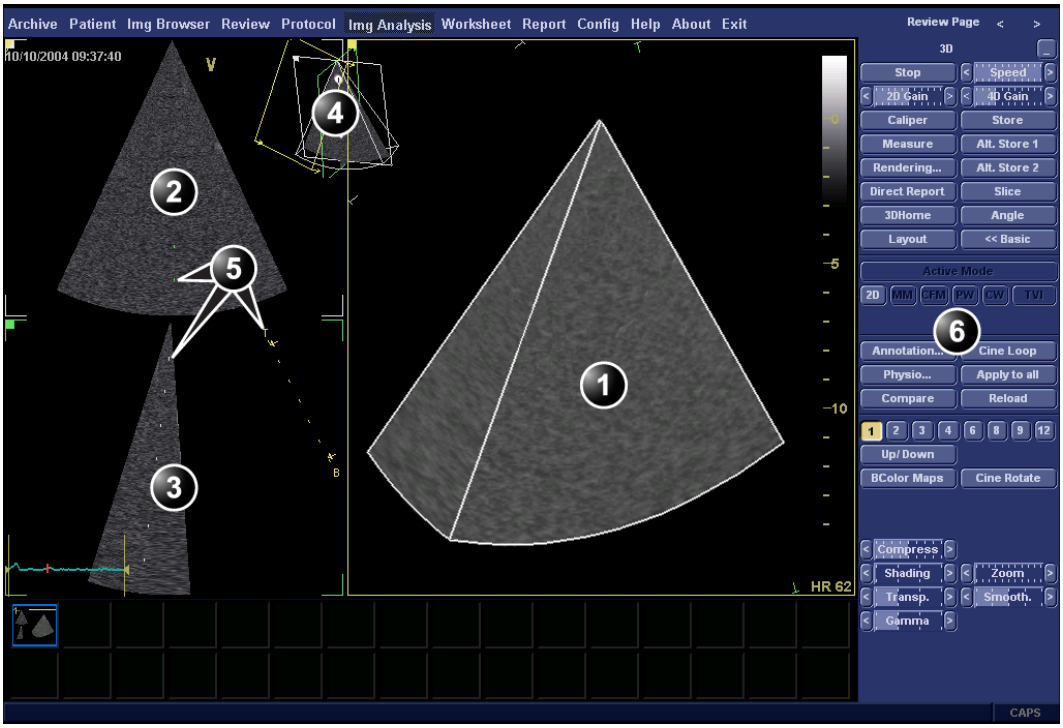
Figure 1-19: Slice rotation adjustment

5. Press **IMG. STORE** to save.

4D mode overview - EchoPAC PC

4D acquisitions from Vivid 7 can be opened and post processed on the EchoPAC PC workstation. This section describes the controls and procedures related to 4D mode on the workstation. Refer to the EchoPAC PC User manual about general use of the workstation.

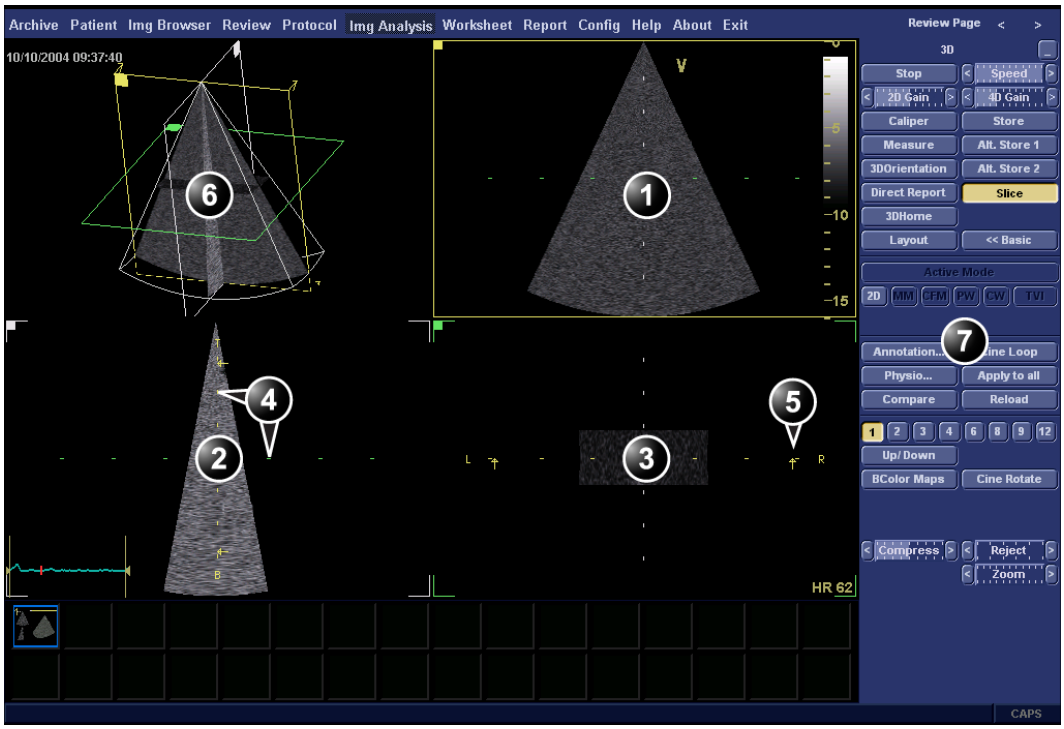
Volume rendering mode screen



1. **Volume rendering display from cut-plane 1 (yellow). The volume rendering may be adjusted by rotating and translating the cut-plane 1.**
2. **Cut-plane 2 (white): 2D image in the azimuth plane.**
3. **Cut-plane 3 (green): 2D image in the elevation plane.**
4. **Orientation window: displays a three-dimensional model with cut-planes position and orientation.**
5. **Color coded cut-plane markers indicate the other cut-planes position relative to the displayed cut-plane.**
6. **4D control panel (Volume rendering mode)**

Figure 1-20: The 4D screen (Volume rendering)

Slice mode screen



1. **Cut-plane 1 (yellow)**
2. **Cut-plane 2 (white)**
3. **Cut-plane 3 (green)**
4. **Color coded cut-plane markers indicate the position of the other cut-planes relative to the displayed cut-plane.**
5. **View direction marker.**
6. **Orientation window: displays a three-dimensional model with cut-planes position.**
7. **4D control panel (Slice mode)**

Figure 1-21: The 4D screen (Slice mode)

4D mode control panel

Refer to '4D mode controls' on page 9 for information on the 4D related controls. All other general imaging controls are described in the workstation User manual.

Figure 1-22: The 4D Control panel

Rendering controls

In volume rendering, select **Rendering** to display the rendering controls.

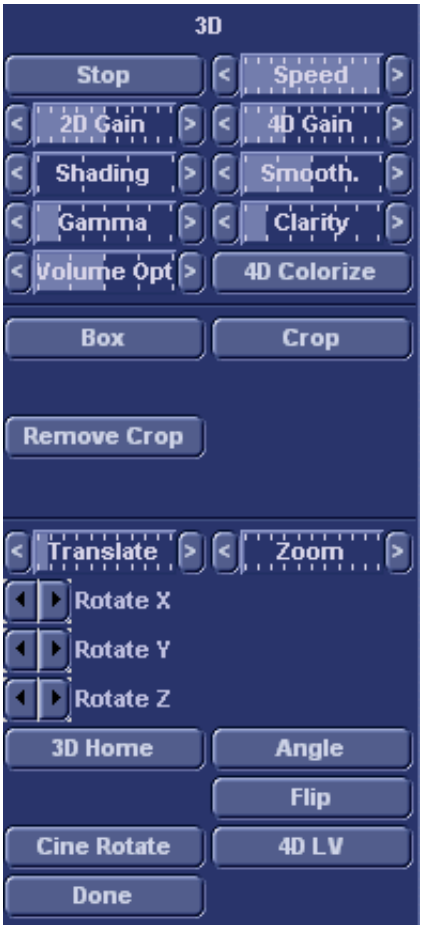


Figure 1-23: Rendering and orientation panel

Display controls

Rotation

Rotation using the mouse

1. Place the mouse cursor in the image area.
2. Press and hold down the **Left mouse button** and drag the mouse in any direction.
   The volume rendering is rotated following the mouse cursor movement.
   To rotate around the Z axis, press and hold down **ALT** and drag the mouse to the left or right.

Rotation from the control panel

1. In Volume rendering, Select **Rendering**.
   The *Rendering control panel* is displayed (see Figure 1-23).
2. Adjust **Rotate X**, **Rotate Y** or **Rotate Z** to rotate the volume rendering around the corresponding axis.

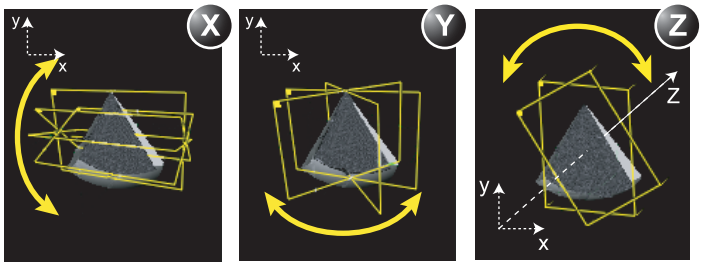


Figure 1-24: Rotation around the X, Y and Z axis

Translation

Translation using the mouse

1. Place the mouse cursor in the image area.
2. Press and hold down **SHIFT** and drag the mouse up or down.
   The volume rendering cut-plane is translated.

Translation from the control panel

1. In Volume rendering, Select **Rendering**.
   The *Rendering control panel* is displayed (see Figure 1-23).
2. Adjust the control **Translate**.

Zoom

Zooming

1. Rotate the **Mouse wheel** to zoom in and out.
   OR
   Press **ARROW UP** to zoom in, **ARROW DOWN** to zoom out.
   OR
   Adjust **Zoom** on the control panel.

Zoom panning

1. While in zoom mode, press and hold down the mouse wheel and drag the mouse.
   OR
   Press and hold down **SHIFT** and press the **ARROW** keys.

Cropping

Free cropping

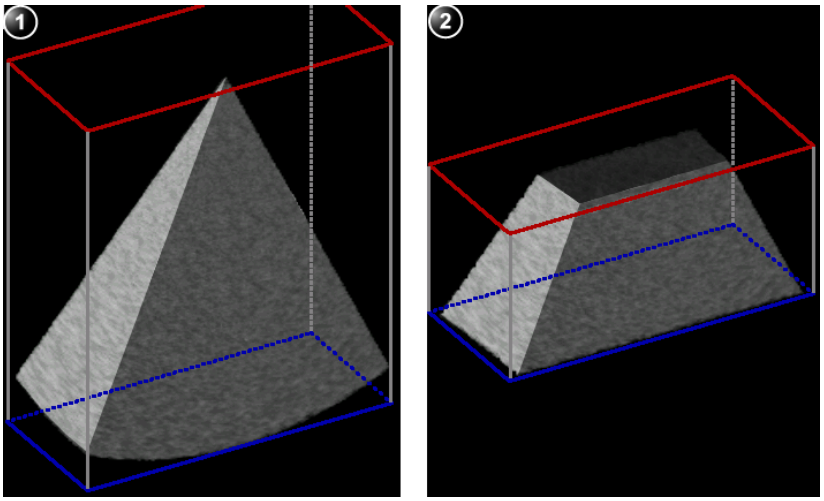
1. Select **Rendering**.
   The *Rendering control panel* is displayed (see Figure 1-23).
2. Select **Crop**.
   Note: Pressing **Crop** will remove any previous Box cropping operations.
3. Rotate and translate the active cut-plane.
   All data above the cut-plane will be removed when applying crop.
4. Press **Set** to apply crop.
   All data up front of the active cut-plane is removed.
5. Repeat steps 3 and 4 to remove other parts of the volume.
   Note: press **Undo** to undo the cropping actions stepwise.
   Press **Remove crop** to undo all cropping actions in one operation.
6. Press **Crop** to exit the Free cropping tool.

Box cropping

1. Select **Rendering**.
   The *Rendering control panel* is displayed (see Figure 1-23).
2. Select **Box**.
   A box frame is displayed with two adjustable sides (highlighted as red and blue), see Figure 1-25.

Note: Pressing **Box** will remove any previous Free cropping operations.

3. Use the **Red** and **Blue** controls to adjust the corresponding sides around the structure of interest.
   All data outside the box is removed.
4. Use the **Box Sides** control to select two other sides of the box.
5. Repeat steps 3 and 4 to adjust the selected sides of the box until the structure of interest is within the box.
   Note: Press **Reset Box** to undo all cropping actions in one operation.
6. Press **Box** to apply and exit Box cropping tool.



1. **Default cropping box with two active sides (red and blue). The other sides can be selected for adjustment**
2. **Cropped volume (from upper and lower sides)**

Figure 1-25: Box cropping

Working with 4D acquisitions - EchoPAC PC

1. In the *Search/Create patient window* (Archive menu), select a patient record with 4D acquisitions.
   The *Examination List window* is displayed.
2. Select the desired examination and open (double-click) a 4D acquisition from the clipboard.
   OR
   Press **Image browser** and open (double-click) the 4D acquisition in the *Image browser screen*.
   The *Volume rendering mode screen* is displayed (see Figure 1-20, page 32).
3. Rotate and translate the volume rendering to display the structure of interest (see page 36).
4. Optimize the volume rendering using **4D Gain**, **Smoothness**, **Shading** controls.
5. If desired, double-click on the image area to display the volume rendering in a single screen.
6. If desired, zoom in the structure of interest (see page 37).
7. If necessary, use the cropping tools to remove unwanted structures (see page 37).
8. If desired, press **Cine rotate** to rotate the volume rendering back and forth.
9. Press **Store** to save the changes.

9 Slice

9 Slice enables simultaneous display of nine short axis views generated from an Apical full volume acquisition.

1. Select an Apical full volume acquisition.
2. Press **9 Slice**.
   The *9 Slice screen* is displayed showing nine short axis views. The slices are evenly distributed and maximized in size for best assessment.
   If required, zoom in. All slices are zoomed in simultaneously.
3. The following adjustments can be done:
   - Adjust **Top** and **Bottom** controls to change the slicing area.
   - Adjust the **Axis 1** and **Axis 2** controls to rotate the slices

backward/forward and sideways, to align the slices with the anatomical structure.

4. Press **Store** to save.

4D LV Volume application

The 4D LV Volume function may be analyzed on the Vivid 7 system or EchoPAC PC workstation using the TomTec 4D LV-Volume application. The 4D LV-Volume application enables analysis of global and regional volume measurement from a Full volume tissue acquisition.

The 4D LV-Volume application is an option.

Measurements generated in the 4D LV-Volume application are saved to the worksheet. The measurements have a specific TomTec label.

In addition 4D tissue acquisitions can be stored on a removable media to a format compatible with the TomTec application using the “Save as” function on the Vivid 7 system or the EchoPAC PC workstation (File format: VolDicom (*.dcm)). Refer to the Vivid 7 or EchoPAC PC user manual for additional information on the “Save as” function.

Starting the 4D LV Volume application — Vivid 7

1. In a 4D Full volume tissue acquisition, press **MEASURE**.
2. Select **Volume** and **4D LV Volume** in the *Measurement menu*.
   The 4D LV-Volume application is started.
   Refer to the TomTec 4D LV-Volume User manual for proper use of the application.

Starting the 4D LV Volume application — EchoPAC PC

1. In a 4D Full volume tissue acquisition, select **4D LV Volume** on the control panel.
   The 4D LV-Volume application is started.
   Refer to the TomTec 4D LV-Volume User manual for proper use of the application.
   Note: the 4D LV Volume application can also be started from the *Measurement menu* as described for the Vivid 7 above, and from the *Rendering and orientation panel* (Figure 1-23).

Chapter 2
4D Color Flow Imaging

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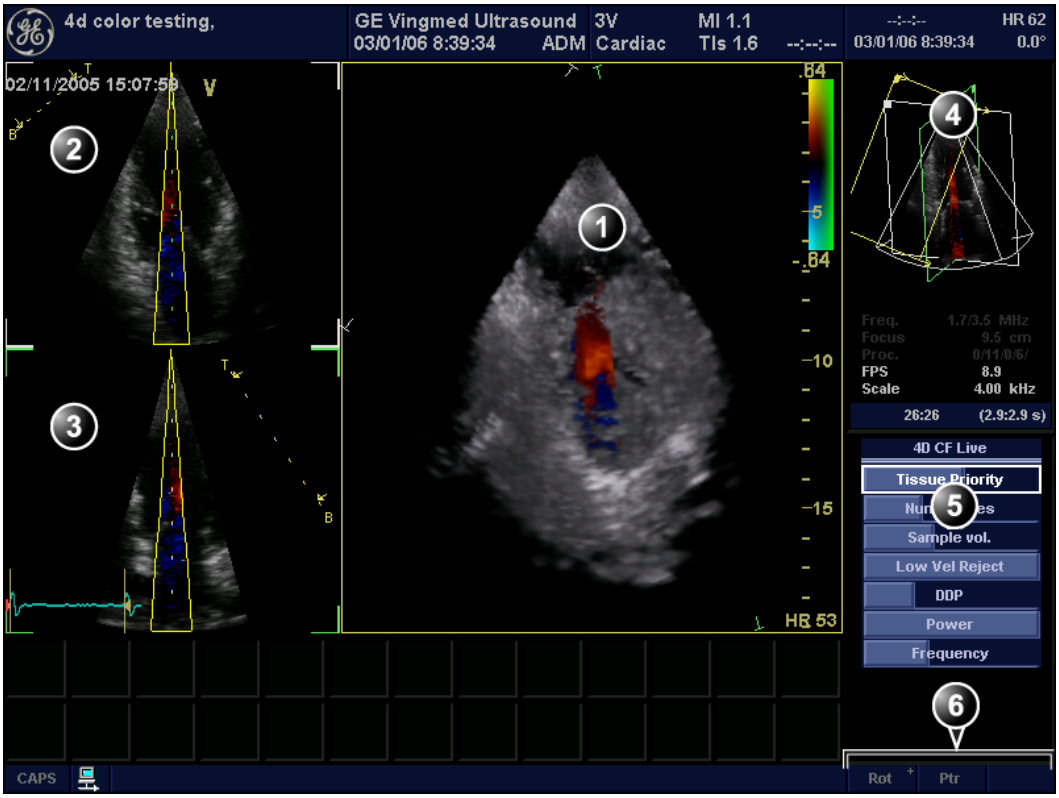
Introduction

The 4D Color Flow Imaging mode enables real time volume rendering display with color flow data. 4D Color Flow imaging based on Full volume acquisition is available.

4D Color Flow mode overview - Vivid 7

Color Flow Volume rendering mode screen



1. **Volume rendering display with Color Flow**
2. **2D Color Flow image in the azimuth plane**
3. **2D Color Flow image in the elevation plane**
4. **Orientation window: displays a three-dimensional model with cut-planes position and orientation.**
5. **Soft menu controls (see page 51)**
6. **Trackball functions (see page 52)**

Figure 2-1: 4D Color Flow screen (Volume rendering)

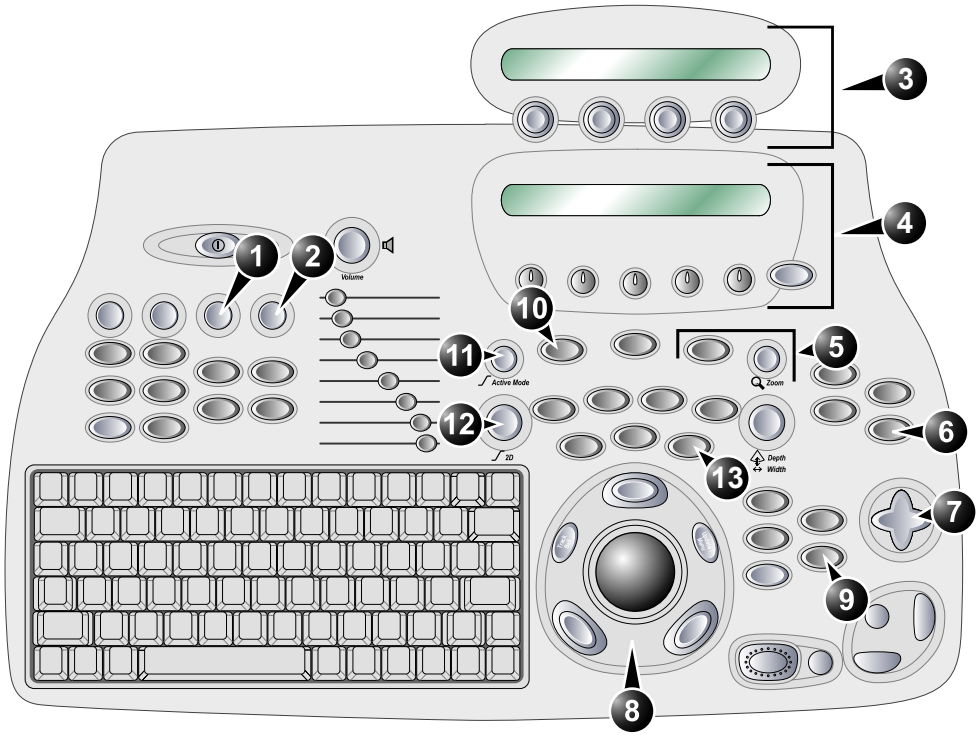
Color Flow Slice mode screen

1. **Cut-plane 1 (yellow)**
2. **Cut-plane 2 (white)**
3. **Cut-plane 3 (green)**
4. **Trackball functions (see page 52)**

Figure 2-2: 4D Color Flow screen (Slice mode)

4D Color Flow mode controls

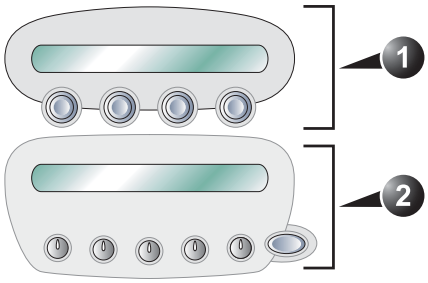
Both Tissue and Color flow mode controls are available. Press **ACTIVE MODE** to toggle between the two modes.



1. **4D key**
2. **Multiplane key**
3. **Assigned 4D rotaries: see next page.**
4. **Assigned 4D keys: see next page.**
5. **Zoom (see page 20)**
6. **Layout (see page 19): toggles the display between:**
   - **Multi screen with volume/slice**
   - **Single screen volume/slice**
7. **Soft menu (see page 51)**
8. **Trackball (see page 52)**
   - **Rotate/translate volume rendering or selected cut-plane (Slice mode)**
   - **Scroll through the cineloop**
9. **Clear: resets the orientation to default positions.**
10. **Angle: predefined orientations optimized for volume rendering.**
11. **Color Gain**
12. **2D Gain**
13. **Color key**

Figure 2-3: 4D Color Flow mode controls on the control panel

Assigned rotaries and keys



Color Flow Volume rendering assigned controls

1. **Assigned rotaries**
   - **Scale**
   - **Baseline R**
   - **Volume size**

   MORE menu
   - **Translate R**

2. **Assigned keys**
   - **Slice R**
   - **Invert**
   - **Crop (in Freeze only) R**
   - **Box (in Freeze only) R**
   - **Cineloop (in Freeze only) R**
   - **4D CF Prepare**
   - **Full Volume**
   - **Color map R**
   - **6 Slice (in Full volume Freeze only) R (page 57)**

   MORE menu
   - **Up/Down R**
   - **Flip R**
   - **Orientation window R**
   - **Cine rotate (in Freeze only) R**
   - **Variance**
   - **4D Colorize R**

Color Flow Slice mode assigned controls

1. **Assigned rotaries**
   - **Rotate R**
   - **Translate (in Freeze only) R**

2. **Assigned keys**
   - **Slice exit R**
   - **Reference plane R**
   - **Cineloop (in Freeze only) R**

   MORE menu
   - **Up/Down R**
   - **Orientation window R**

Controls marked with **R** are also available in cine replay.

Figure 2-4: Color Flow Volume rendering and Slice mode assigned controls

4D Color Flow mode assigned controls

Scale

Adjusts the repetition rate of the Doppler pulses transmitted to acquire the data for color flow mapping. The Scale (Nyquist limit) should be adjusted so that no aliasing occurs, while still having good resolution of velocities. The Nyquist limit should be somewhat above the maximum velocity found in the data.

Baseline

Adjusts the color map to emphasize flow either toward or away from the probe.

Volume size

The volume size control enables the adjustment of the color ROI. ROI adjustment may affect volume rate and/or resolution.

Slice/Slice exit

Toggles the display between Volume rendering and Slice mode.

Invert

Enables the color scheme assigned to positive and negative velocities to be inverted.

Variance

Controls the amount of variance data added to a color display. Variance enables computer-aided detection of turbulent flow (e.g. jets or regurgitation).

4D Colorize

(Volume rendering, Live and Replay)

Adjusts the volume rendering color from a color map menu.

Reference plane

(Slice mode, Live and Replay)

Toggles the cut-plane selection between cut-plane 1, 2 or 3.

Crop (Free cropping)

See page 12.

Box (Box cropping)

See page 13.

4D CF Prepare and Full volume

Enables preparation and acquisition of a color flow full volume based on ECG triggered sub-volume acquisitions of color flow data. Depending on the adjustment, four or seven heart cycles are acquired. The 4D CF Prepare control enables the user to adjust the probe placement for optimized color flow acquisition from a bi-plane display before acquiring the Full volume with color flow data (see page 55).

Color maps

Displays a menu of color map options. Each color map is assigning different color hues to different velocities.

6 Slice

6 Slice enables simultaneous display of six evenly distributed short axis views and two long axis views (in the azimuth and elevation planes) generated from an Apical full volume color flow acquisition (see page 57).

Additional 4D mode assigned controls

The following controls are available after pressing **MORE**.

Up/Down

Flips the volume 180 degrees.

Flip

Flips the view position.

Orientation window

Shows/hides the *Orientation window*.

Cine rotate

Rotates back and forth the volume rendering.

Soft menu controls

Soft menu controls are related to image quality adjustment. These controls are accessed using the 4-way rocker on the control panel. Only the 4D controls are described in this section, refer to the system user manual for general imaging controls.

Number of cycles

(Volume rendering, Live)

Controls the number of heart cycles the ECG triggered color flow full volume acquisition is based on. Select between four or seven heart cycles.

Low velocity reject

Enables the extent of low velocity removal to be adjusted.

Flow transparency

(Volume rendering, Replay only)

Adjusts the color flow data transparency level. Higher setting may provide a better visualization of flow turbulences.

Tissue transparency

(Volume rendering, Replay only)

Adjusts the transparency level of the tissue structure. Maximum setting makes the tissue information invisible, leaving only color flow data displayed.

Flow direction

(Volume rendering, Replay only)

Enables to show/hide positive and/or negative velocities.

Smoothness

(Volume rendering, Replay only)

Smooths color rendering. Smoothness affects continuity of color display and image noise.

Trackball controls

The trackball has multiple functions. The trackball functions are organized in several functional groups as shown in the table below.

The function selected is displayed in the lower right corner of the screen.

- Press **SELECT** to toggle between the trackball functions within the active functional group. Groups with several functions are marked with a + symbol.
- Press **TRACKBALL** to toggle between the functional groups.

Orientation controls group	
Function	**Description**
Press **SELECT** to toggle between the controls.	
Rotate	Rotates the volume rendering/slice.
Translate	Translates the volume rendering/slice.

Cineloop control group	
Function	**Description**
Scroll	Scrolls through a cineloop.
Speed	Adjust cine replay speed

Display controls

Color key

Starts/stops the color mode. In 4D color freeze, pressing **COLOR** show/hide the color data.

Layout key on the front panel

This control is working the same way as in 4D Mode (see page 19).

Active mode Gain

With Color flow mode activated: gain amplifies the overall strength of echoes processed in the Color Flow window

Zoom

See page 20.

Using 4D Color Flow mode - Vivid 7

Color Flow can be enabled in 2D mode before entering 4D mode or when in 4D mode.

Real time 4D Color flow acquisition

1. Select the 3V probe and cardiac application.
2. Create an examination.
3. Press **4D** and **COLOR**.
   The 4D Color Flow mode is started.
4. Acquire a volume.
5. Press **FREEZE**, **2D FREEZE** and rotate the volume to check the result.
6. Press **IMG. STORE**.

△
CAUTION

Tissue structures may obscure relevant flow information. If required, increase* TISSUE TRANSPARENCY *setting.

Color flow data may obscure other relevant color flow information (e.g jet). If required adjust* FLOW TRANSPARENCY *setting.

In some settings the volume rate can be less than 10 volumes per second. This may lead to small display mismatch between the color and tissue data. This is because of the rapid movement of structures (e.g. valves) compared to the time lag between the tissue and the color volume acquisitions.

Full volume Color Flow acquisition

Full volume Color Flow acquisition is based on ECG triggered sub-volume acquisitions of color flow data. Depending on the adjustment, four or seven heart cycles are acquired.

Full volume Color Flow acquisition is done in two steps:

- Step 1: positioning of the probe for optimal full volume acquisition with color flow data. This is done from a Bi-plane screen displaying azimuth and elevation planes.
- Step 2: acquisition over seven heart beats.

△
CAUTION

ECG triggering acquisition may by nature contain artifacts. The triggering works by acquiring the whole tissue volume during the first heart beat, followed by a series of color sub-volumes that are stitched together (three or six). Consequently, the tissue volume is updated only each fourth or seventh heart beat, and only the color data may have stitching artifacts.

Artifacts may be caused by:

- ***Movements of the probe caused by the operator during acquisition.***
- ***Movements of the patient during acquisition.***
- ***Irregular heart rate during acquisition.***

To validate the acquisition, perform a visual inspection in both the volume rendering and the elevation plane. Stitching artifacts are shown as visible transitions between the sub-volumes in the color flow data.

1. Connect the ECG device and make sure to obtain a stable ECG trace.
2. Adjust **Num. Cycles** to either four or seven cycles.
3. In 4D Color Flow mode, press **4D CF PREPARE**.
   A Bi-plane screen is displayed. Acquire an apical view.
4. Adjust the probe position to display optimal color flow image in both planes. You may:
   - adjust **VOLUME SIZE** to change the color ROI size.
   - change the position of the ROI using the trackball (**POS**).
5. Ask the patient to hold her/his breath at end expiration. Keep the probe steady and press **FULL VOLUME**. The Full volume acquisition is started. the tissue color volume are build up over four/seven heart cycles. Make sure to keep the probe steady during the entire acquisition.

Press **FREEZE**.

6. In Freeze, look for stitching artifacts in the color flow data in both the volume rendering and the elevation plane in the lower left window of the screen.
7. Press **2D FREEZE**, rotate the volume to check the result. Depending on the result, you may press **4D CF PREPARE** and make a new acquisition.
8. Press **IMG. STORE**.

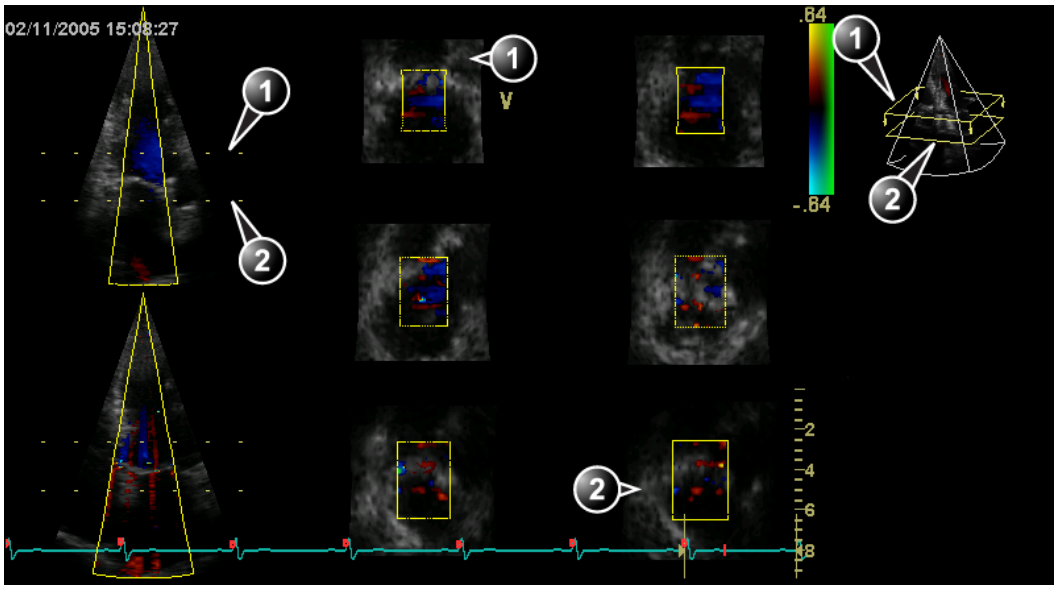
6 Slice

The purpose of the 6 slice mode is to be able to measure the size of the minimal area of a regurgitant flow jet, typically through the mitral valves.

6 Slice enables simultaneous display of six short axis views generated from an Apical full volume Color Flow acquisition and two apical long axis views.

6 Slice is available only from a full volume color flow acquisition when in Freeze.

1. Acquire an apical Full volume view (see page 55).
2. Press **FREEZE**.
3. Press **6 SLICE**.
   The *6 Slice screen* is displayed (Figure 2-5). The six slices are evenly distributed and maximized in size for best assessment.

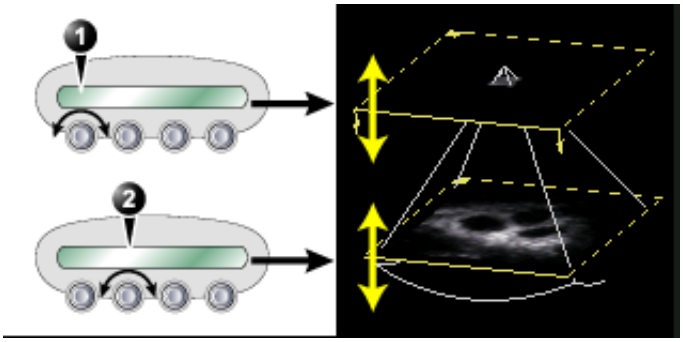


1. **Upper slice**
2. **Lower slice**

Figure 2-5: 6 Slice screen

If required, zoom in. All slices are zoomed in simultaneously.

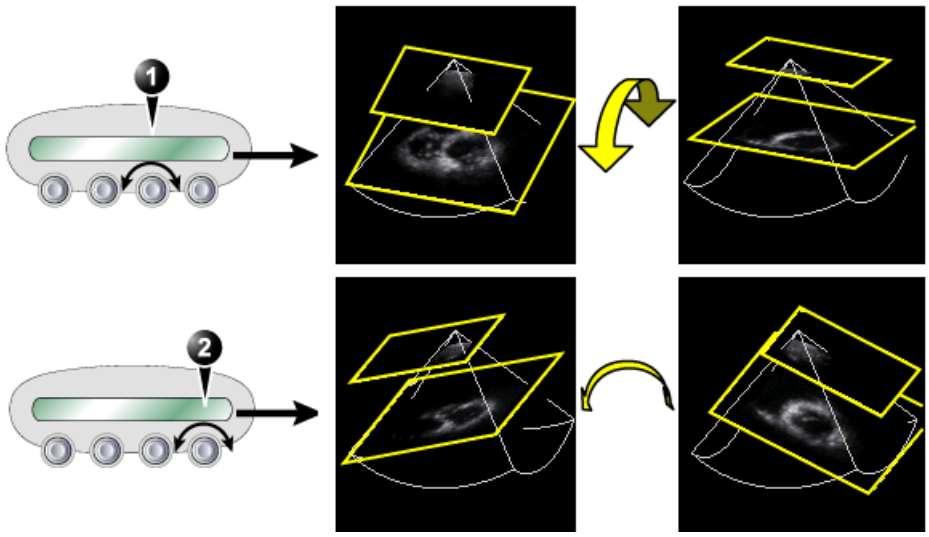
4. The following adjustments can be done:
   - Adjust **TOP** and **BOTTOM** controls to change the slicing area (Figure 2-6).



1. **Top: upper slice adjustment**
2. **Bottom: lower slice adjustment**

Figure 2-6: Slice distribution adjustment

   - Adjust the **AXIS 1** and **AXIS 2** controls to rotate the slices backward/forward and sideways (Figure 2-7), to align the slices with the anatomical structure.



1. **Axis 1: slice rotation backward/forward**
2. **Axis 2: slice rotation sideways**

Figure 2-7: Slice rotation adjustment

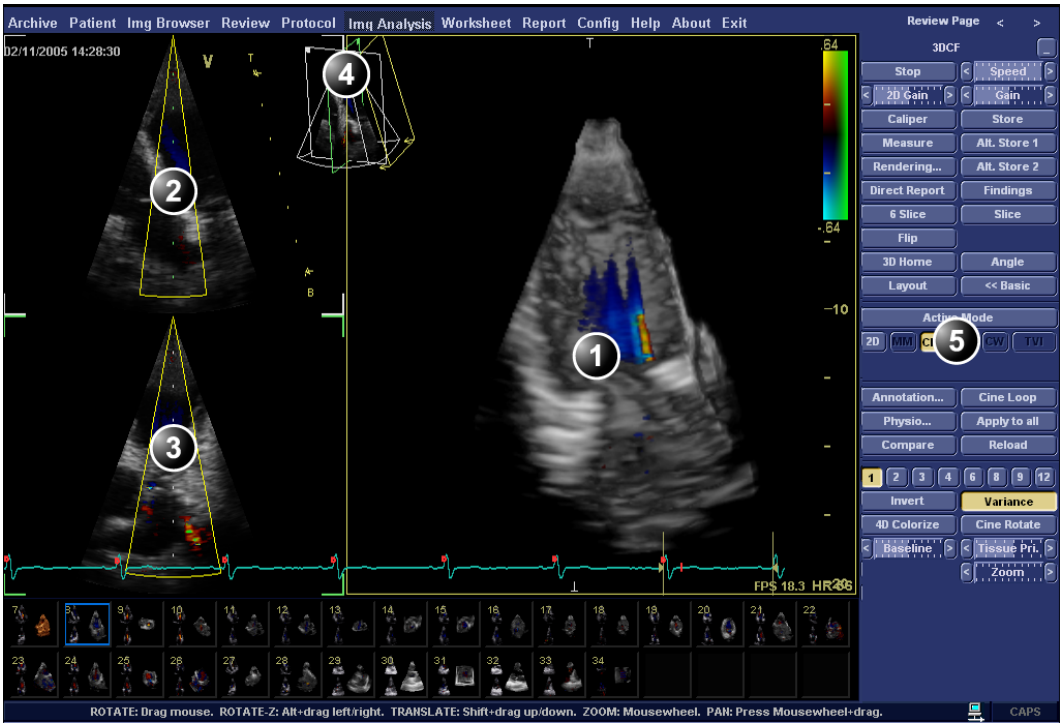
- Adjust **ROTATE** to rotate all six slices around the center axis.
- Adjust **TRANSLATE** to move all six slices up or down.

5. Press **IMG. STORE** to save.
6. Press **6 SLICE EXIT**.

4D Color Flow mode overview - EchoPAC PC

4D Color Flow mode acquisitions from Vivid 7 can be opened and post processed on the EchoPAC PC workstation. The controls are the same as in the Vivid 7 (see page 49). The procedures related to the 4D Color Flow mode are similar to the 4D mode (see page 32).

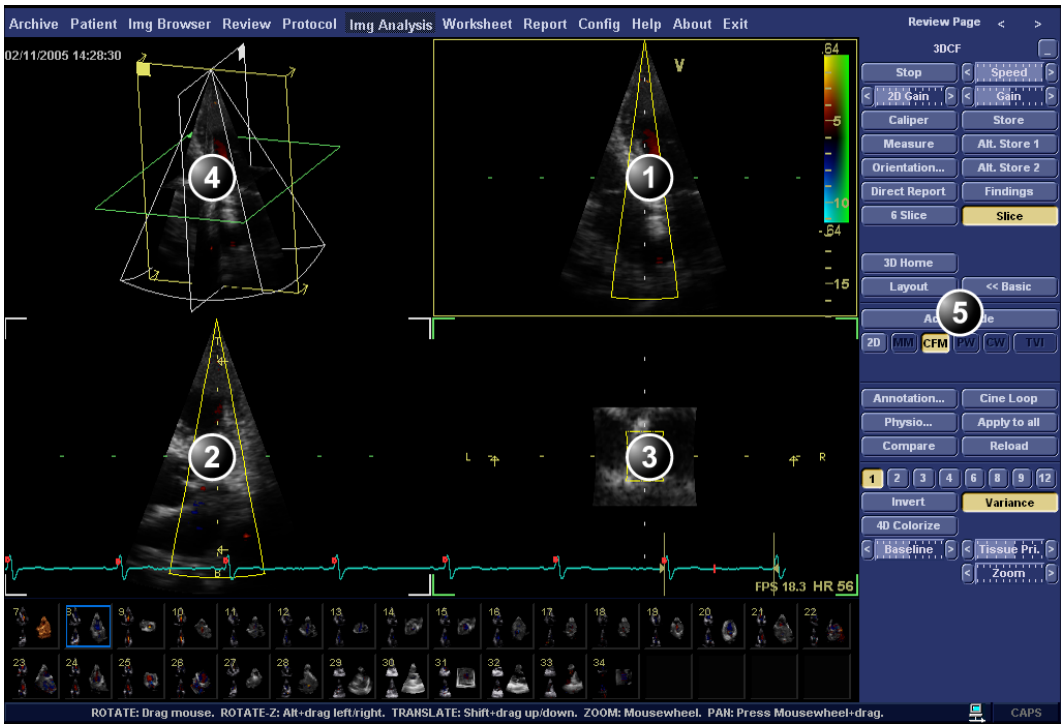
Volume rendering mode screen



1. **Volume rendering display with Color Flow**
2. **Cut-plane 2 (white): 2D image in the azimuth plane**
3. **Cut-plane 3 (green): 2D image in the elevation plane**
4. **Orientation window: displays a three-dimensional model with cut-planes position and orientation.**
5. **4D control panel (Color Flow Volume rendering mode)**

Figure 2-8: 4D Color Flow screen (Volume rendering)

Slice mode screen



1. **Cut-plane 1 (yellow)**
2. **Cut-plane 2 (white)**
3. **Cut-plane 3 (green)**
4. **Orientation window: displays a three-dimensional model with cut-planes position.**
5. **4D control panel (Color Flow Slice mode)**

Figure 2-9: 4D Color Flow screen (Slice mode)

4D mode control panel

Refer to '4D Color Flow mode assigned controls' on page 49 for information on the 4D Color Flow related controls. All other general imaging controls are described in the workstation User manual.

Figure 2-10: 4D Color Flow Control panel

Rendering controls

In volume rendering, select **Rendering** to display the rendering controls.

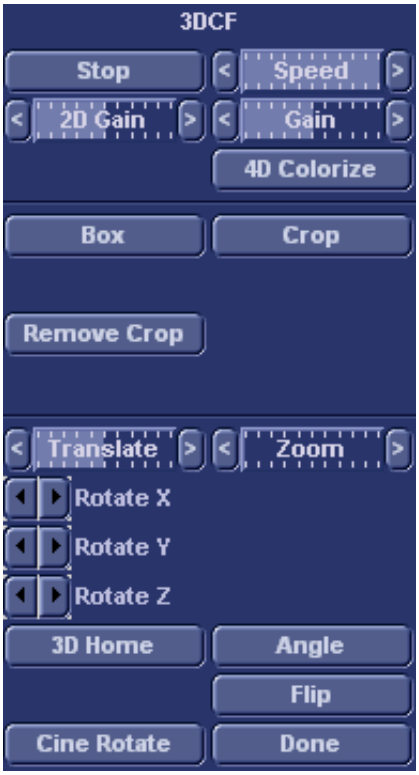


Figure 2-11: Rendering and orientation panels

Chapter 3
Multi-plane imaging

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Introduction

Multi-plane mode displays two (Bi-plane) or three (Tri-plane) rotated cross sections acquired simultaneously. This mode enables the investigation of anatomical structures from different angles.

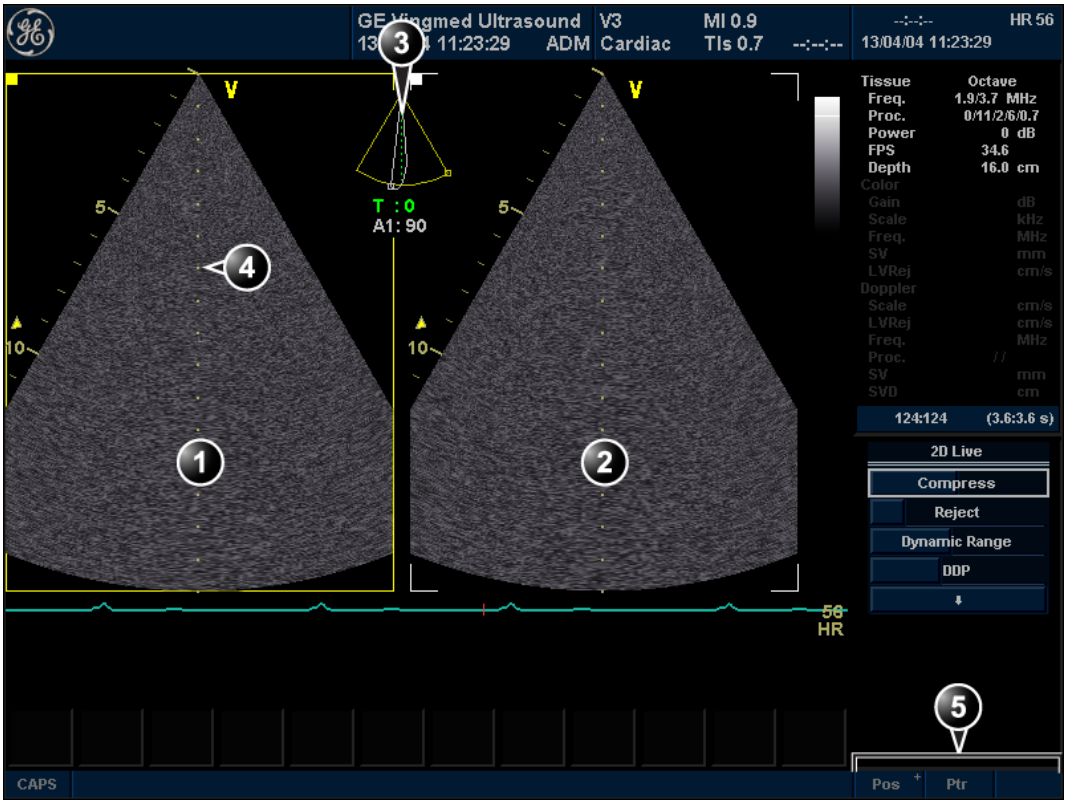
Multi-plane mode enables the creation of a left ventricular volume reconstruction based on contours drawn from three cross sections at both end-systole and end-diastole with calculation of end-systolic and end-diastolic volumes and ejection fraction (see Chapter 4, ’Measurements and Analysis’ on page 87).

Combined to specially designed Stress echo protocols, the Multi-plane mode enables faster stress examination as two projections can be acquired simultaneously (see Chapter 5, ’Multi-plane Stress Echo’ on page 101).

Multi-plane mode is available from B-Mode, Color flow mode and TVI related modes.

Multi-plane mode overview - Vivid 7

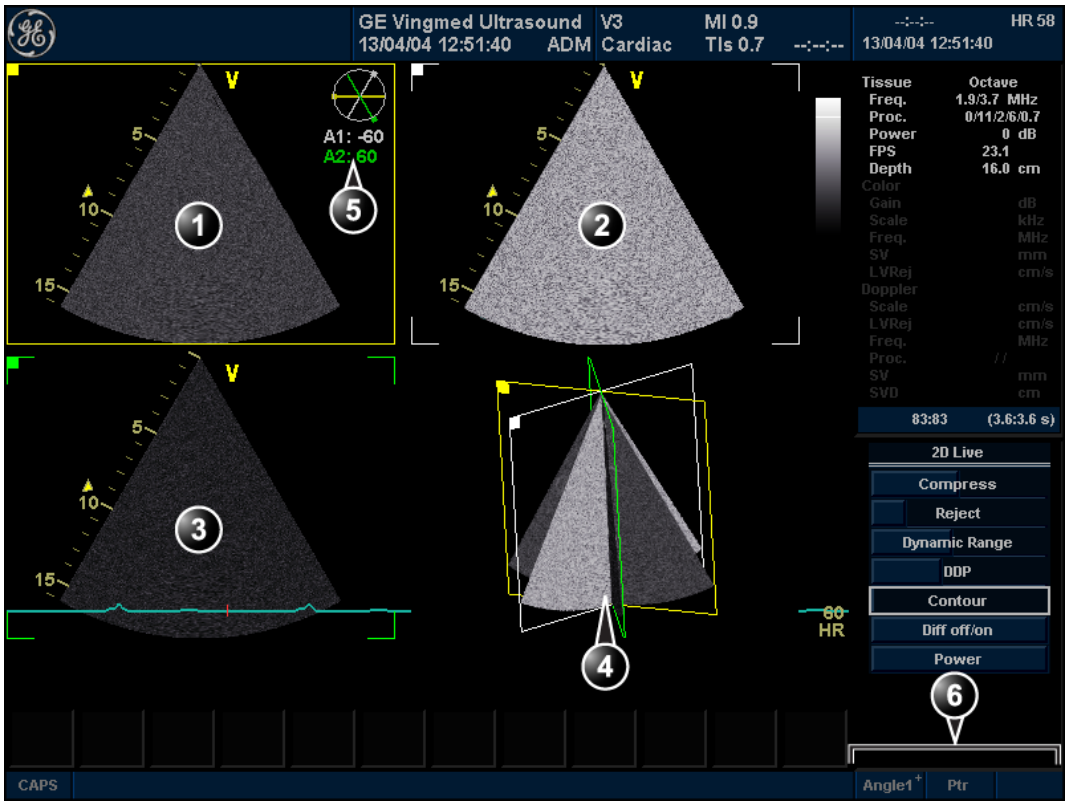
Bi-plane mode screen



1. **Scan plane 1 (yellow): default reference scan plane. This scan plane is fixed, cannot be tilted or rotated.**
2. **Scan plane 2 (white): this scan plane is by default perpendicular to scan plane 1 along the scanning axis. This scan plane can be either tilted or rotated.**
3. **Geometric model: displays both scan planes in a projection and the rotation angle (A1) and tilt angle (T) values for the scan plane 2 relative to the scan plane 1.**
4. **Scan plane marker for scan plane 2: crossing line of scan plane 2 in scan plane 1.**
5. **Trackball functions (see page 73)**

Figure 3-1: The Bi-plane imaging mode screen

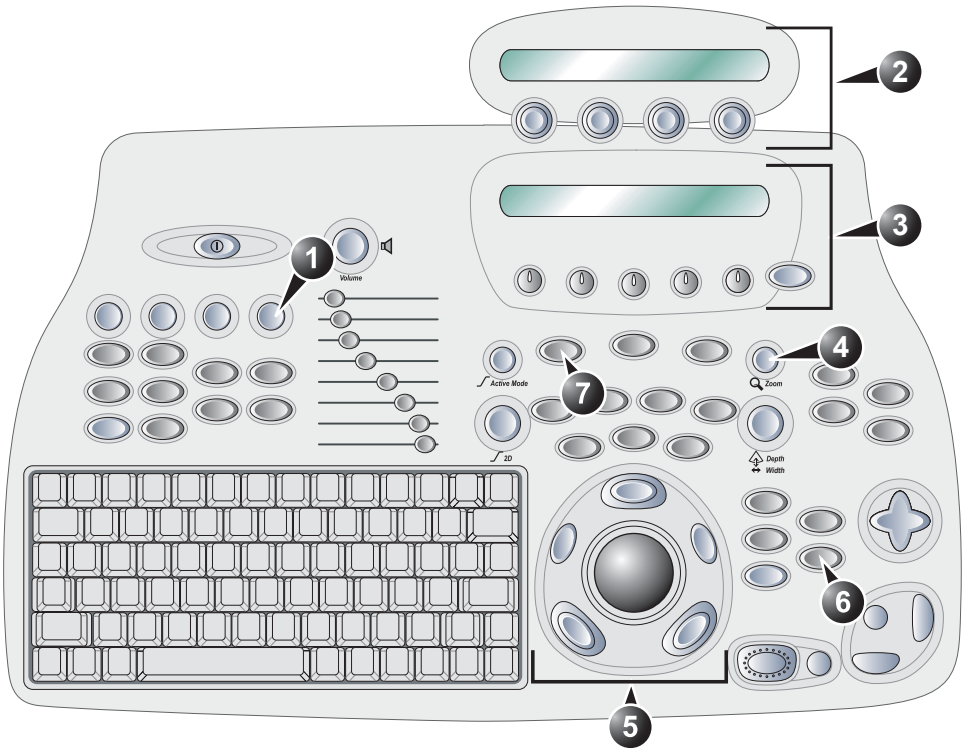
Tri-plane mode screen



1. **Scan plane 1 (yellow): default reference scan plane. This scan plane is fixed, cannot be rotated.**
2. **Scan plane 2 (white): this scan plane can be rotated using the trackball.**
3. **Scan plane 3 (green): this scan plane can be rotated using the trackball.**
4. **Geometric model: displays all the scan planes in a projection.**
5. **Navigator: displays rotation angle values for the scan planes 2 (A1) and 3 (A2) relative to the scan plane 1.**
6. **Trackball functions (see page 73)**

Figure 3-2: The Tri-plane imaging mode screen

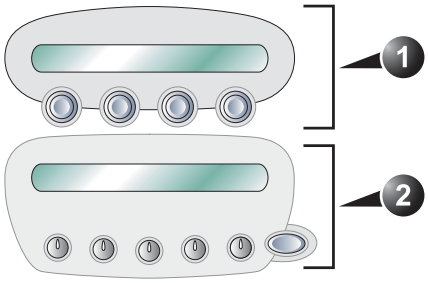
Multi-plane mode controls



1. **Multi-plane key**
2. **Mode specific assigned rotaries: see next pages.**
3. **Mode specific assigned keys: see next pages.**
4. **Zoom**
5. **Trackball**
   - **Tilt scan plane 2 (Bi-plane mode only).**
   - **Rotate scan plane 2 and 3**
   - **Zoom adjustment.**
   - **Scroll through the cineloop.**
6. **Clear: resets the rotation and/or tilt angle of scan plane 2 and 3.**
7. **Angle: in Bi-plane mode, rotates scan plane 2 to a pre-defined angle relatively to scan plane 1.**

Figure 3-3: The Multi-plane controls on the control panel

Assigned rotaries and keys



¨Multi-plane B mode assigned controls

1. **Assigned rotaries**
   - **Angle 1 (Tri-plane)**
   - **Angle 2 (Tri-plane)**
   - **Width (Bi-plane)**
   - **Frequency (Bi-plane)**
   - **Focus position**
   - **Frame rate**

   ALT menu
   - **Angle 1 (Bi-plane)**
   - **Width (Tri-plane)**
   - **Frequency (Tri-plane)**

2. **Assigned keys**
   - **Up/Down R**
   - **Reference Plane R**
   - **Tri-plane**
   - **Cineloop (in Freeze only) R**
   - **B Color maps R**

   ALT menu
   - **Curved Anatomical M Mode R**
   - **Q Analysis (in Freeze only)**
   - **Anatomical M Mode**
   - **Tissue Tracking**
   - **Strain rate**
   - **Strain**

   ALT + **MORE** menu
   - **TSI**

Multi-plane Color flow mode assigned controls

1. **Assigned rotaries**
   - **2D Width**
   - **Scale**
   - **Baseline R**
   - **Frame rate**

   MORE menu
   - **Angle 1**
   - **Angle 2 (Tri-plane)**

2. **Assigned keys**
   - **Invert R**
   - **Variance R**
   - **Reference Plane R**
   - **Tri-plane**
   - **Cineloop (in Freeze only) R**
   - **Color map R**

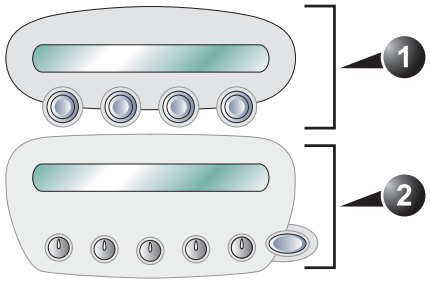
   MORE menu
   - **Up/Down R**

   ALT menu
   - **Same as Multi-plane B mode**

   ALT + **MORE** menu
   - **Same as Multi-plane B mode**

Controls marked with **R** are also available in cine replay.

Figure 3-4: Multi-plane B mode and CF modes assigned controls



Multi-plane TVI mode assigned controls

1. **Assigned rotaries**
   - **2D Width**
   - **Scale**
   - **Baseline R**
   - **Frame rate**

   MORE menu
   - **Angle 1**
   - **Angle 2 (Tri-plane)**

2. **Assigned keys**
   - **Invert R**
   - **TSI R**
   - **Reference Plane R**
   - **Tri-plane**
   - **Cineloop (in Freeze only) R**
   - **TVI visible R**

   ALT menu
   - **Curved Anatomical M Mode R**
   - **Q Analysis (in Freeze only)**
   - **Anatomical M Mode**
   - **Tissue Tracking**
   - **Strain rate**
   - **Strain**

   ALT + **MORE** menu
   - **TSI**

Multi-plane Tissue Tracking mode assigned controls

1. **Assigned rotaries**
   - **2D Width**
   - **Track scale R**
   - **Track end R**
   - **Frame rate**

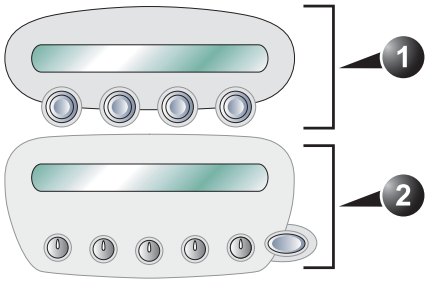
   MORE menu
   - **Angle 1**
   - **Angle 2 (Tri-plane)**

2. **Assigned keys**
   - **Invert R**
   - **TSI R**
   - **Reference Plane R**
   - **Tri-plane**
   - **Cineloop (in Freeze only) R**
   - **Color maps R**

   ALT menu
   - **Same as Multi-plane TVI**

Controls marked with **R** are also available in cine replay.

Figure 3-5: Multi-plane TVI and TT modes assigned controls



Multi-plane Strain imaging mode assigned controls

1. **Assigned rotaries**
   - **2D Width**
   - **Strain scale R**
   - **Strain end R**
   - **Frame rate**

   MORE menu
   - **Angle 1**
   - **Angle 2 (Tri-plane)**

2. **Assigned keys**
   - **Invert R**
   - **TSI R**
   - **Reference Plane R**
   - **Tri-plane**
   - **Cineloop (in Freeze only) R**
   - **Color maps R**

   ALT menu
   - **Curved Anatomical M Mode**
   - **Q Analysis (in Freeze only)**
   - **Anatomical M Mode**
   - **Tissue Tracking**
   - **Strain rate**
   - **Strain**

   ALT + MORE menu
   - **TSI**

Multi-plane Strain rate imaging mode assigned controls

1. **Assigned rotaries**
   - **2D Width**
   - **SRI scale R**
   - **Frame rate**

   MORE menu
   - **Same as Multi-plane Strain imaging**

2. **Assigned keys**
   - **Same as Multi-plane Strain imaging**

Multi-plane Tissue Synchronization Imaging mode assigned controls

1. **Assigned rotaries**
   - **2D Width**
   - **Frame rate**

   MORE menu
   - **TSI start**
   - **TSI end**

2. **Assigned keys**
   - **TSI R**
   - **Reference Plane R**
   - **Tri-plane**
   - **Cineloop (in Freeze only)**
   - **Color maps R**

   ALT menu
   - **Same as Multi-plane Strain imaging**

Controls marked with **R** are also available in cine replay.

Figure 3-6: Multi-plane SI, SRI and TSI modes assigned controls

Multi-plane mode assigned controls

This section describes only the Multi-plane mode controls. The scanning mode controls are described in the system User manual.

Tri-plane

(All modes, Live)

Toggles between Bi-plane and Tri-plane mode.

Reference Plane

(All modes, Live and Replay)

In Tri-plane mode, toggles the reference plane between scan plane 1, 2 or 3.

The reference plane may also be selected using the trackball when the Pointer trackball tool selected (see below).

Trackball controls

The trackball has multiple functions depending on the scanner's state (Live/Freeze, zoom/unzoom, Bi-plane/Tri-plane mode and selected scanning mode). The trackball functions are organized in several functional groups as shown in the table below. The function selected is highlighted in the lower right corner of the screen.

- Press **SELECT** to toggle between the trackball functions within the active functional group.
- Press **TRACKBALL** to toggle between the functional groups.

Scan planes rotation controls group		
Function	**State**	**Description**
Press **SELECT** to toggle between the controls.		
Pos	Bi-plane, Live, Unzoom	Tilts the scan plane 2 (white) around the top of the sector.
Angle 1	Bi-plane/Tri-plane, Live, Unzoom	Adjusts the angle between the scan planes 2 (white) and scan plane 1 (yellow). Scan plane 2 is rotated around the crossing line between the scan planes. Scan plane 1 is fixed.

Scan planes rotation controls group		
Function	**State**	**Description**
Angle 2	Tri-plane, Live, Unzoom	Adjusts the angle between the scan planes 3 (green) and scan plane 1 (yellow). Scan plane 1 is fixed.

Scan plane selection		
Function	**State**	**Description**
Pointer	All states	Selects the reference scan plane.

Zoom mode controls group		
Function	**State**	**Description**
Press **SELECT** to toggle between the controls.		
Pos	Zoom, Live/Freeze	Moves the zoom area.
Size	Zoom, Live/Freeze, 2D	Resizes the zoom area.

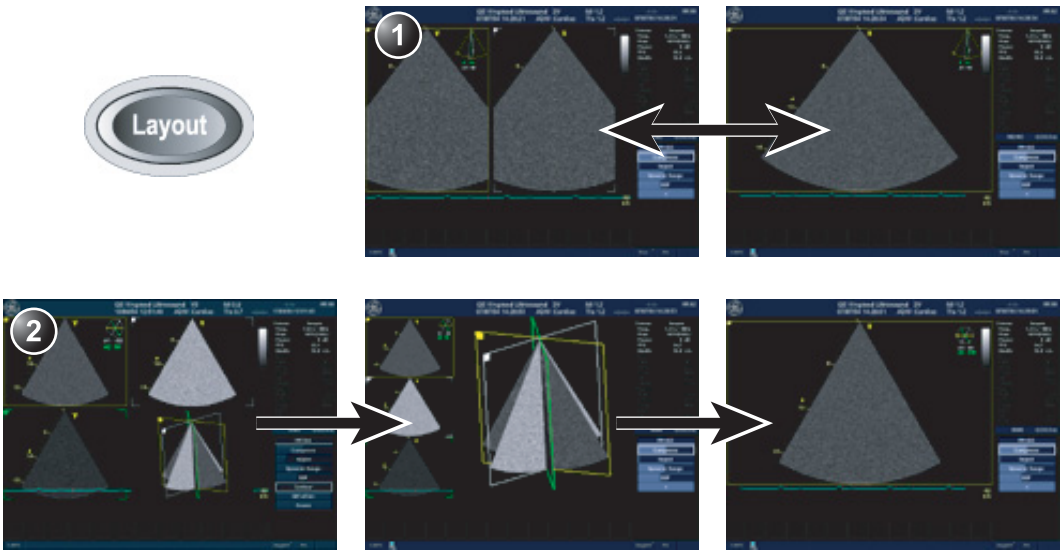
Color/TVI modes ROI controls group		
Function	**State**	**Description**
Press **SELECT** to toggle between the controls.		
Pos	CFM, TVI modes, Live/Freeze, Zoom/Unzoom	Moves the color sector. In Bi-plane CFM mode, if scan plane 1 (yellow) is selected as reference scan plane, both color sectors are moved. If scan plane 2 (white) is selected as reference scan plane its color sector is moved independently. In Tri-plane CFM mode, all sectors are moved at the same time.
Size	CFM, TVI modes, Live/Freeze, Zoom/Unzoom	Resizes the color sector. All sectors are resized at the same time

Cineloop control group		
Function	**State**	**Description**
Scroll	Freeze, Zoom/Unzoom	Scrolls through a cineloop.

Display controls

Layout key

- In Bi-plane mode, toggles the display between the default Bi-plane dual screen and a single screen showing the selected scan plane.
- In Tri-plane mode, toggles the display between the default Tri-plane quad screen, a quad screen with enlarged *Geometric model* and a single screen showing the selected scan plane.



1. **Display options for Bi-plane mode**
2. **Display options for Tri-plane mode**

Figure 3-7: Multi-plane mode display options

Zoom

Display zoom

Activated and adjusted by rotating the ZOOM rotary (). An orientation preview showing the outlined magnified area is displayed in the upper right corner of the screen. The position and size of the magnified area are adjusted with the trackball when in B mode (see page 79).

High Resolution (HR) zoom

HR zoom concentrates the image processing to a magnified user selectable portion of the image, resulting in an improved image quality in the selected image portion.

HR zoom is activated and adjusted by pressing and rotating the zoom rotary (). An orientation preview showing the outlined magnified area is displayed in the upper right corner of the screen. The position and size of the magnified area are adjusted with the trackball.

Other controls

Clear key

Resets all scan planes to the default position.

Angle key

In Bi-plane mode, toggles the position of scan plane 2 between the default position and a pre-defined angle relatively to scan plane 1.

Using Multi-plane mode imaging - Vivid 7

1. Select the 3V probe.
2. Create an examination.
3. Press **MP** on the control panel.
   The *Bi-plane B mode screen* is displayed.
4. Press **TRI-PLANE** to select between bi-plane or tri-plane acquisition.
5. Adjust the angle increment between scan planes as described below.
6. If in Bi-plane mode, adjust the scan plane 2 tilt angle as described below.
7. To activate another scanning mode:
   - Press **COLOR** to activate CF mode.
   - Press **TVI** to activate TVI mode.
   - In TVI mode, press **TSI** to activate TSI mode.
   - Press **ALT** and either **TISSUE TRACKING**, **STRAIN** or **STRAIN RATE** to activate the corresponding mode in Multi-plane imaging.
8. Zoom in the structure of interest (see page 79).
   Note: scan plane rotation or tilting cannot be done when in zoom mode.
9. Press **IMG. STORE** to save the acquisition.

Scan plane rotation

The angle increment of scan plane 2 or 3 relative to the scan plane 1 (fixed) can be adjusted with the trackball. The rotation is done around the crossing line between the scan planes. Scan plane rotation is available only in Unzoom live mode.

1. Press **SELECT** until the desired trackball function is selected:
   - **Angle 1**: rotation of scan plane 2 (white)
   - **Angle 2**: rotation of scan plane 3 (green, Tri-plane)
2. Use the trackball to rotate the corresponding scan plane around the probe center axis.

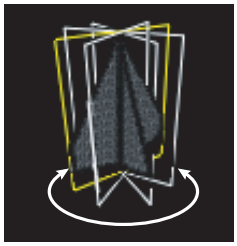


Figure 3-8: Rotation of Scan plane 2 (Bi-plane mode)

3. To reset the scan planes to the original default position, press **CLEAR**.

Tilting scan plane 2

In Bi-plane mode, the scan plane 2 can be tilted around the top of the scanning sector using the trackball. Tilting is available only in Unzoom live mode.

1. In Bi-plane mode, press **SELECT** until the trackball function **Pos** is selected.
2. Use the trackball to tilt the scan plane 2.

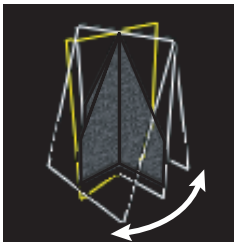


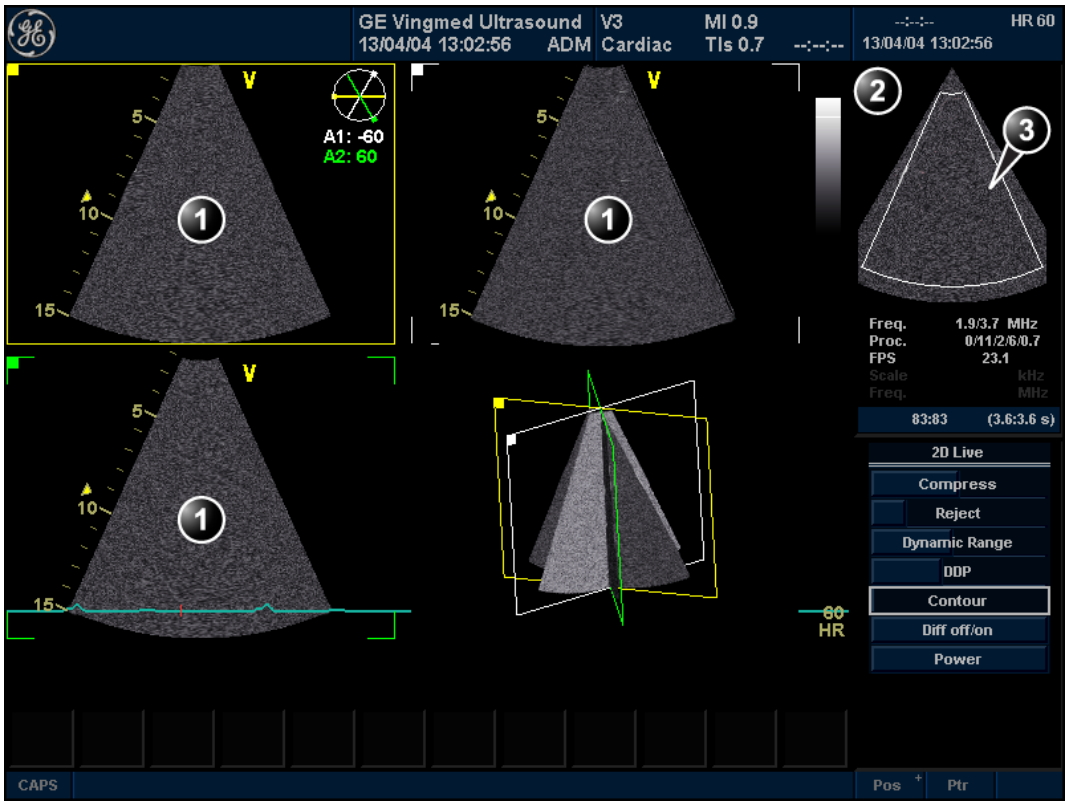
Figure 3-9: Tilting of scan plane 2 (Bi-plane mode)

3. To reset the scan planes to the original default position, press **CLEAR**.

Zooming

Activating the zoom

1. Rotate the **ZOOM** knob clockwise on the control panel. All scan plane images are zoomed in. A *Navigation window* is displayed with a frame highlighting the zoomed area (see Figure 3-10).



1. **Magnified scan planes**
2. **Navigation window in Zoom mode**
3. **Zoomed area**

Figure 3-10: Zoom mode screen (Tri-plane mode)

Adjusting the zoomed area

The zoomed are can be moved within the sector or resized.

1. In zoom mode, press **SELECT** to toggle the trackball function to **Pos** and use the trackball to freely move the zoomed area within the scan plane.
2. Press **SELECT** to toggle the trackball function to **Size** and use the trackball to adjust the size of the zoomed area (B mode only).

Note: If the trackball function **Ptr** (mouse pointer) or **Scroll** (when in Freeze) is selected, press **TRACKBALL** until the trackball functions **Pos** or **Size** is selected.

Multi-plane mode overview - EchoPAC PC

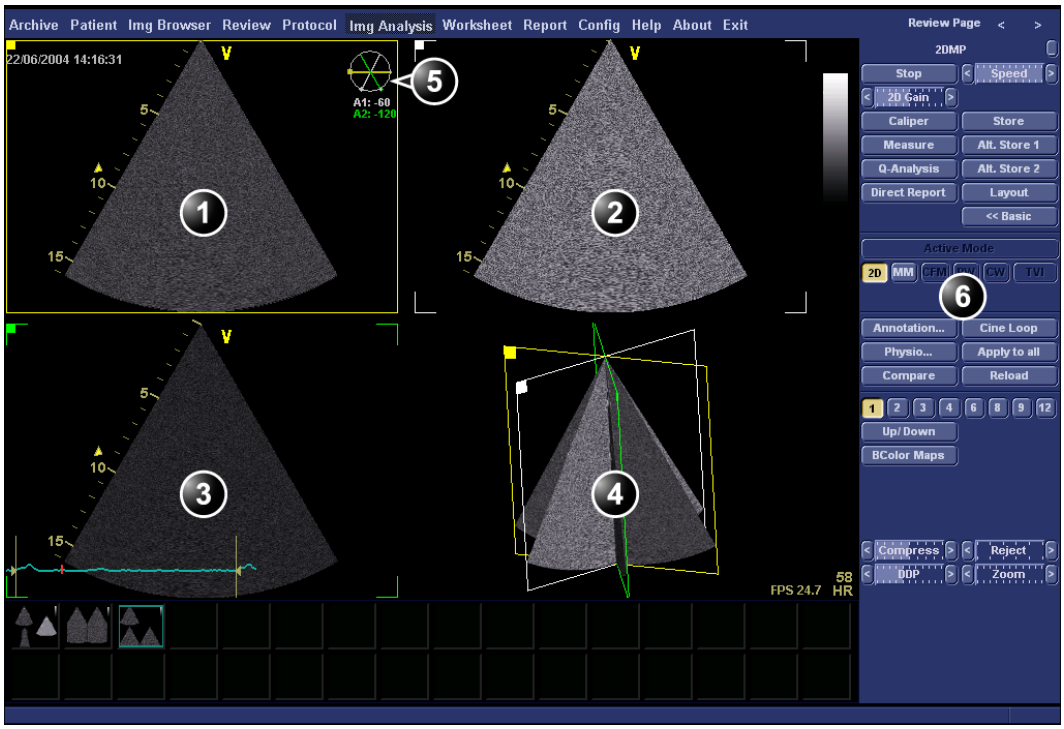
Multi-plane acquisitions from Vivid 7 can be opened and post processed on the EchoPAC PC workstation. This section describes the controls and procedures related to Multi-plane mode on the workstation. Refer to the EchoPAC PC User manual about general use of the workstation.

Bi-plane mode screen

1. **Scan plane 1 (yellow): default reference scan plane.**
2. **Scan plane 2 (white): the tilt or rotation angle is set during acquisition.**
3. **Geometric model: displays both scan planes in a projection and the rotation angle (A1) and tilt angle (T) values for the scan plane 2 relative to the scan plane 1.**
4. **Scan plane marker for scan plane 2: crossing line of scan plane 2 in scan plane 1.**
5. **Multi-plane control panel**

Figure 3-11: The Bi-plane mode screen

Tri-plane mode screen



1. **Scan plane 1 (yellow): default reference scan plane.**
2. **Scan plane 2 (white): the rotation angle is set during acquisition.**
3. **Scan plane 3 (green): the rotation angle is set during acquisition.**
4. **Geometric model: displays all three scan planes in a projection and/or reconstructed volume.**
5. **Navigator: displays rotation angle values for the scan planes 2 (A1) and 3 (A2) relative to the scan plane 1.**
6. **Multi-plane control panel**

Figure 3-12: The Tri-plane mode screen

The multi-plane control panel

The controls in multi-plane mode are similar to the controls for the associated scanning mode (B mode, Color or TVI related modes). Refer to the workstation User manual for additional informations on these controls.

Figure 3-13: The Multi-plane Control panel

Working with multi-plane acquisitions - EchoPAC PC

1. In the *Search/Create patient window* (Archive menu), select a patient record with multi-plane acquisitions.
   The *Examination List window* is displayed.
2. Select the desired examination and open (double-click) a multi-plane acquisition from the clipboard.
   OR
   Press **Image browser** and open (double-click) the multi-plane acquisition in the *Image browser screen*.
   The *Multi-plane mode screen* (bi-plane or tri-plane) is displayed.
3. Perform image optimization and measurements.
4. Press **Store** to save the changes.

Chapter 4
Measurements and Analysis

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Introduction

All cardiac measurements available in 2D are also available in 4D (when in Slice mode) and Multi-plane modes. In addition, the 4D and Multi-plane modes enable the creation of a left ventricular volume reconstruction based on contours drawn from three cross-sections at both end-systole and end-diastole with calculation of the end-systolic and end-diastolic volumes and the ejection fraction.

Left ventricular volume measurement may also be performed in Bi-plane mode based on contours drawn at both end-systole and end-diastole.

Refer to the scanner’s or the workstation’s User Manual for more information about 2D measurements.

From the TSI Tri-plane mode the user can create a TSI surface model of the left ventricle.

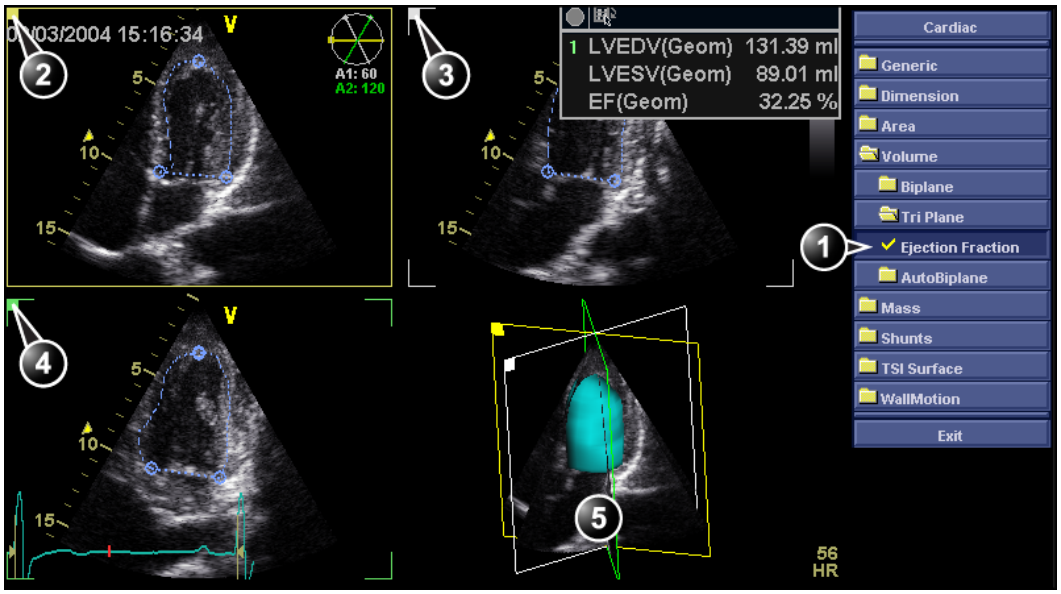
All these features are available on both Vivid 7 and EchoPAC PC.

Left ventricular volume measurements

Tri-plane acquisition

This procedure describes the calculation and reconstruction of the left ventricular volume from a Tri-plane acquisition.

1. In Tri-plane mode, acquire an Apical 4 chamber view in scan plane 1 (yellow).
2. Rotate scan plane 2 and 3 to display an Apical 2 chamber view in scan plane 2 (white) and an Apical long axis view in scan plane 3 (green).
3. Press **FREEZE**.
4. Press **MEASURE**.
   The *Measurement menu* is displayed.
5. In the *Measurement menu* select **Volume** and **Tri-plane**.
   The *Measurement screen* is displayed with the *Ejection fraction tool* selected (see Figure 4-1).
   The end diastolic frame of the current cardiac cycle is displayed and the cursor is moved to the reference scan plane.



1. **Ejection fraction tool for Tri-plane**
2. **Scan plane 1 (yellow): Apical 4 chamber view**
3. **Scan plane 2 (white): Apical 2 chamber view**
4. **Scan plane 3 (green): Apical long axis view**
5. **Volume reconstruction**

Figure 4-1: The Tri-plane measurement screen

6. If desired, press **LAYOUT** twice to display the reference scan plane in a single screen.
7. Place the cursor to the start point for the trace.
8. Press **SELECT** and draw a contour of the left ventricle.
   To edit the contour while drawing:
   - Follow the contour backward to erase it and redraw.
   - Press **UNDO** or **BACKSPACE** to erase the contour stepwise and redraw.
   - Press **DELETE** to remove the entire contour and redraw.
9. Press **SELECT** to complete the contour.
   The cursor is automatically moved to the next scan plane. The crossing point of the trace done in the first scan plane is marked in the second scan plane.

10. Draw a contour of the left ventricle in scan plane 2 and 3 following the same procedure.
    When the last end-diastolic contour is drawn, an end-systolic frame is automatically displayed. The system automatically enters scroll mode. Using the trackball, ensure that the correct end-systolic frame is displayed. Press **SELECT** to leave scroll mode.
11. Repeat steps 7 to 10 to draw a contour of the left ventricle at end-systole in all the scan planes.
    The measurement results, including end-diastolic and end-systolic volumes and the left ventricular ejection fraction, are displayed in the *Measurement result table*.
    Note: Other measurements may be displayed by configuring the *Measurement menu*, refer to the scanner's or workstation's User manual for more information about *Measurement menu* configuration.
12. If in single screen mode, press **LAYOUT** to display the Volume reconstruction of the left ventricle in the *Geometric model*.
13. Press **LAYOUT** again to display an enlarged *Geometric model*.
    The Volume reconstruction can be rotated in all directions (see page 93).

Full volume acquisition

This procedure describes the calculation and reconstruction of the left ventricular volume from a Full volume acquisition.

△
CAUTION

ECG triggering acquisition may by nature contain artifacts, that may have impact on the measurements.

Artifacts may be caused by:

- ***Movements of the probe caused by the operator during acquisition.***
- ***Movements of the patient during acquisition.***
- ***Irregular heart rate during acquisition.***

See recommendations on page 23 to avoid stitching artifacts during full volume acquisition.

It is recommended to specify in the Comments for the examination that the measurements are performed in a Full volume acquisition.

1. Using the Full volume acquisition mode (see page 23), acquire a 4D Apical 4 chamber image.
2. Press **FREEZE**.
3. Orientate the reference cut-plane to display an Apical 4 chamber (see ’Rotating/Translating the 4D image’ on page 25).
4. Press **MEASURE**.
   The *Measurement menu* is displayed.
5. In the *Measurement menu* select **Volume** and **Tri-plane**.
   The *Measurement screen* is displayed with the *Ejection fraction tool* selected.
6. Follow the procedure described in ’Tri-plane acquisition’ on page 89from step 6.

Rotation of the Volume reconstruction

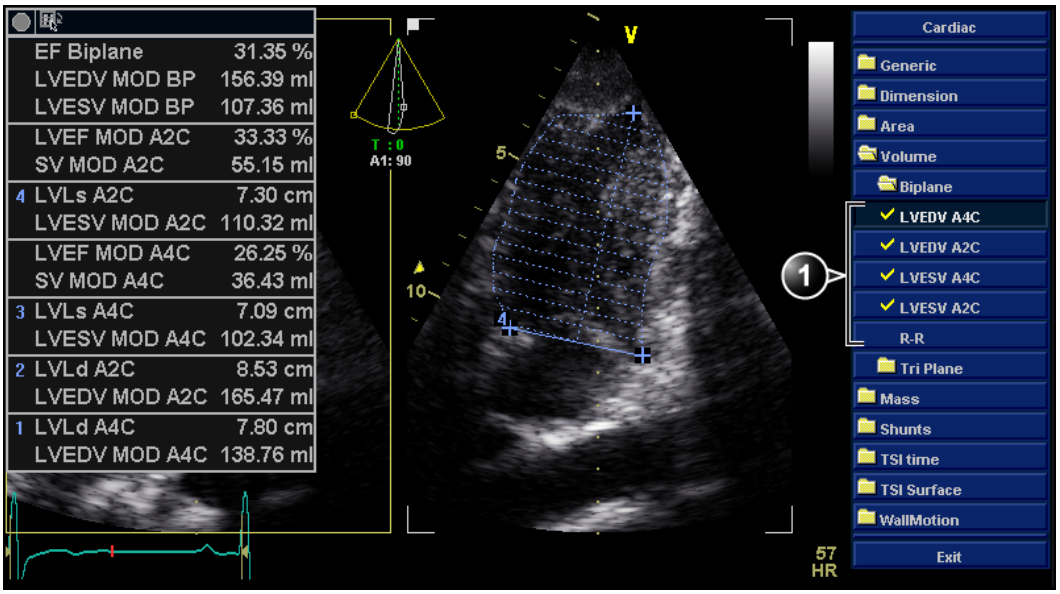
The volume reconstruction displayed in the *Geometric model* can be rotated in any directions.

1. Place the pointer in the *Geometric model*.
2. Press and hold down **SELECT** and use the trackball to rotate the volume reconstruction.

Bi-plane acquisition

This procedure describes the calculations of the left ventricular volume from a Bi-plane acquisition. The volume calculation is based on the Method of disk.

1. In Bi-plane mode, acquire an Apical 4 chamber view in scan plane 1(yellow).
2. If required, rotate scan plane 2 to display an Apical 2 chamber view.
3. Press **FREEZE**.
4. Using the trackball, scroll through the cineloop to display the end-diastolic frame.
5. Press **MEASURE**.
   The *Measurement menu* is displayed.
6. In the *Measurement menu* select **Volume** and **Bi-plane**.
   The *Trace tool* for the Left ventricular end-diastolic volume for the Apical 4 chamber view is selected (see Figure 4-2).



1. **Trace tools**

Figure 4-2: The Volume measurement screen (Bi-plane)

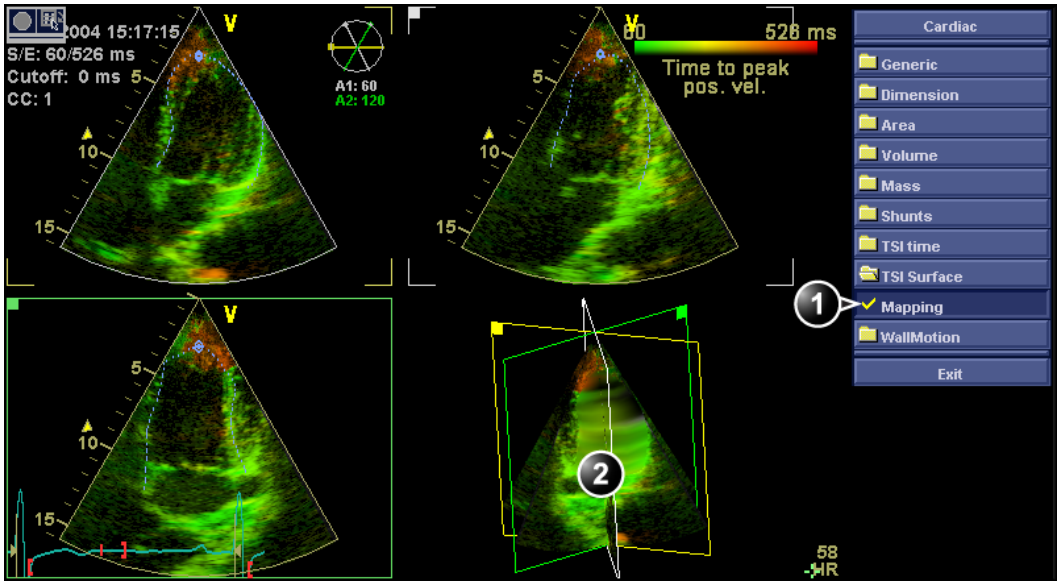
7. In scan plane 1 (yellow), place the cursor to the start point for the trace.

8. Press **SELECT** and draw a contour of the left ventricle.
9. Move the cursor to the apex and press **SELECT** to measure the length.
   The trace tool for the Left ventricular end-diastolic volume for the Apical 2 chamber view is selected.
10. Repeat steps 8 and 9 in the scan plane 2 (measurement in the Apical 2 chamber view).
    The trace tool for the Left ventricular end-systolic volume for the Apical 4 chamber view is selected.
11. Using the trackball, scroll through the cineloop to display the end-systolic frame in the same heart cycle.
12. Press **TRACKBALL** to activate the **M&A** tool.
13. Repeat steps 7 to 10 to perform the end-systolic measurements in the Apical 4 chamber and 2 chamber views.
    The Ejection fraction (Bi-plane) and the end-diastolic and end-systolic left ventricular volumes are calculated.

TSI surface model

A Surface model representation of the left ventricle with TSI color coding can be generated from a TSI Tri-plane acquisition by applying a sampling path in the myocardium. The sampling path is created by placing control points in the myocardium.

1. In Tri-plane TSI mode, acquire an Apical 4 chamber view in scan plane 1 (yellow).
2. Rotate scan plane 2 and 3 to display an Apical 2 chamber view in scan plane 2 (white) and an Apical long axis view in scan plane 3 (green).
3. Press **FREEZE**.
4. Press **MEASURE**.
   The *Measurement menu* is displayed.
5. In the *Measurement menu* select **TSI surface**.
   The *Mapping tool* is selected (see Figure 4-3).



1. **Mapping tool for Geometry model**
2. **TSI surface model**

Figure 4-3: The Measurement screen (Geometry model)

6. In scan plane 1 (yellow), place the cursor to the start point for the sampling path starting in the myocardium.
7. Move the cursor following the myocardium and press **SELECT** to place new points.
   By creating several control points the sampling path can be bent to follow the myocardium.
8. Press **SELECT** twice to end the sampling path.
9. Create a sampling path in scan plane 2 and 3.
   A TSI color coded surface model is displayed in the *Geometric model*.
10. To create a dynamic model, scroll to another frame in the same heart cycle and create a sampling path in each scan plane.
11. Press **2D FREEZE** to run the model.

To edit the sampling path

1. Place the cursor over a control point.
2. Press **SELECT** twice (double-click) and move the control point to a new position using the trackball.
3. Press **SELECT** to place the control point to its new position.

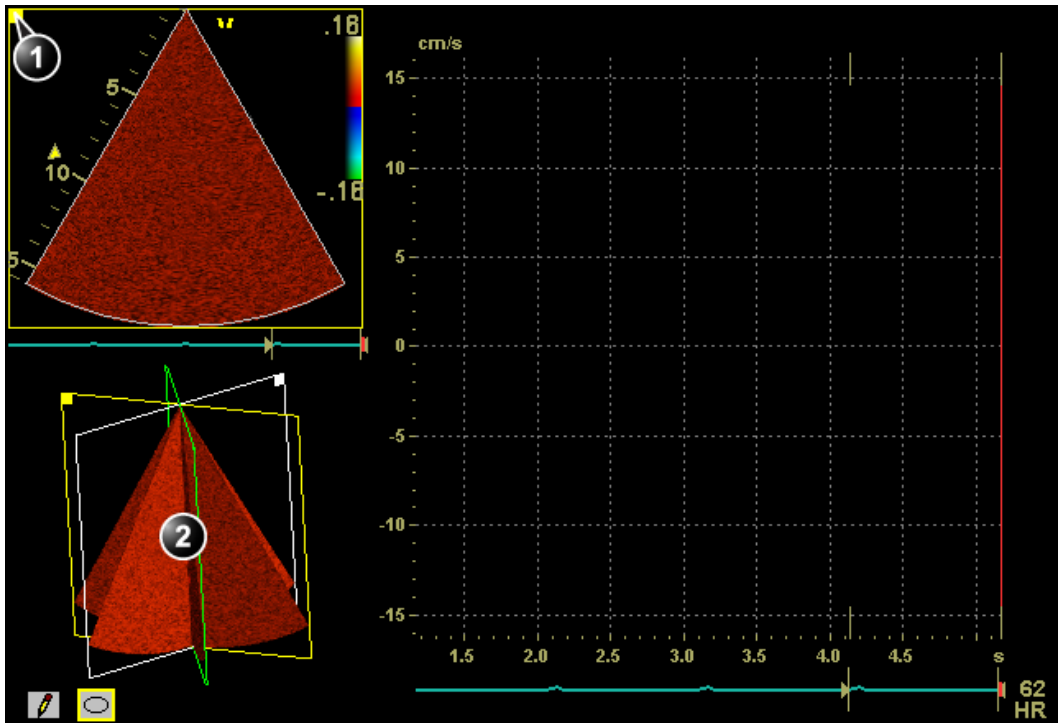
Quantitative analysis

Multi-plane acquisitions (all modes) can be further analyzed in the Quantitative analysis software package. Refer to the scanner's or the workstation's User manual for additional information on Quantitative analysis.

This section describes how to launch the Quantitative analysis software package from the Multi-plane mode and the features that are specific to multi-plane acquisitions.

Starting Quantitative analysis from a multi-plane acquisition

1. From a Multi-plane (Bi-plane or Tri-plane) acquisition, press **FREEZE**.
2. Press **ALT** and press the assigned key **Q ANALYSIS**.
   The *Quantitative analysis screen* is displayed showing the selected scan plane and the *Geometric model*.
3. To change scan plane, press **Reference Image**.



1. **Selected scan plane**
2. **Geometric model**

Figure 4-4: The Quantitative analysis screen

Chapter 5
Multi-plane Stress Echo

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- • Launching the Template editor 104
- • Stress Template setup 104

• Stress test acquisition 106
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Introduction

The Multi-plane mode can be used with specially designed stress templates (factory or user-defined) that enables simultaneous acquisition of several projection planes into each cell in the template.

Two factory multi-plane stress templates are available:

- **Pharm. 4x2 Multiplane**: consists of:
  - Four levels: Baseline, Low dose, Peak dose and Recovery
  - Two columns:

    - A Tri-plane mode column with simultaneous acquisition of Apical 4 chamber, Apical 2 chamber and Apical long axis views.

    - A Bi-plane mode column with simultaneous acquisition of Parasternal long axis and Parasternal short axis views.
- **Pharm. 4x3 Biplane**: consists of:
  - Four levels: Baseline, Low dose, Peak dose and Recovery
  - Three columns:

    - A Bi-plane mode column with simultaneous acquisition of Apical 4 chamber, and Apical 2 chamber views.

    - A Bi-plane mode column with simultaneous acquisition of Apical 4 chamber and Apical long axis views.

    - A Bi-plane mode column with simultaneous acquisition of Parasternal long axis and Parasternal short axis views.

  Note: this template acquires the 5 standard projections using only biplane acquisition, this results in higher resolution / framerate than using triplane. The probe is fixed on the 4 chamber projection when acquiring both apical biplane recordings (only the second plane is changing).

The following section describes:

- The basic procedure to create a Multi-plane pharmacological stress template
- The Multi-plane stress acquisition based on the Multi-plane pharmacological stress template

- The Multi-plane stress analysis

Note: Not all Stress Echo features are described in the following example, refer to the system User manual for additional information on Stress Echo.

Creating a Multi-plane stress test template

The following example describes the creation of a pharmacological protocol template consisting of:

- Three levels:
  - Baseline
  - Low dose
  - Peak dose
- Two columns:
  - A Tri-plane mode column with simultaneous acquisition of Apical 4 chamber, Apical 2 chamber and Apical long axis views.
  - A Bi-plane mode column with simultaneous acquisition of Parasternal long axis and Parasternal short axis views.

Launching the Template editor

1. Press **PROTOCOL**.
2. Select **Template**.
   The *Template pop-up menu* is displayed.
3. Select **Template editor**.
   The *Template editor screen* is displayed.

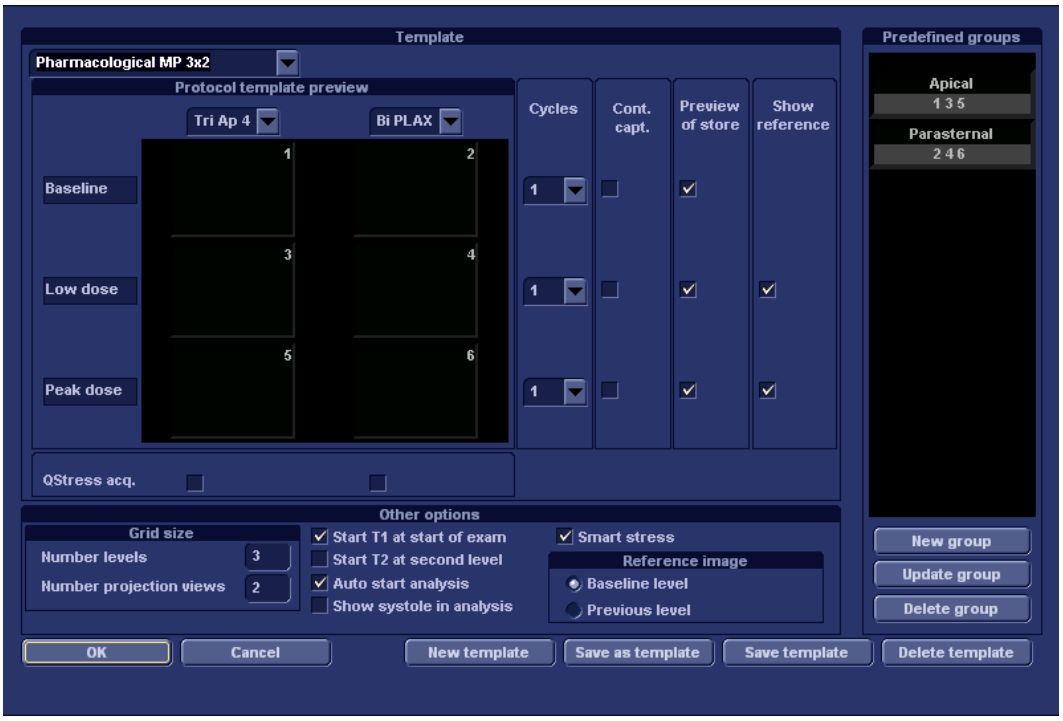


Figure 5-1: The Template editor screen

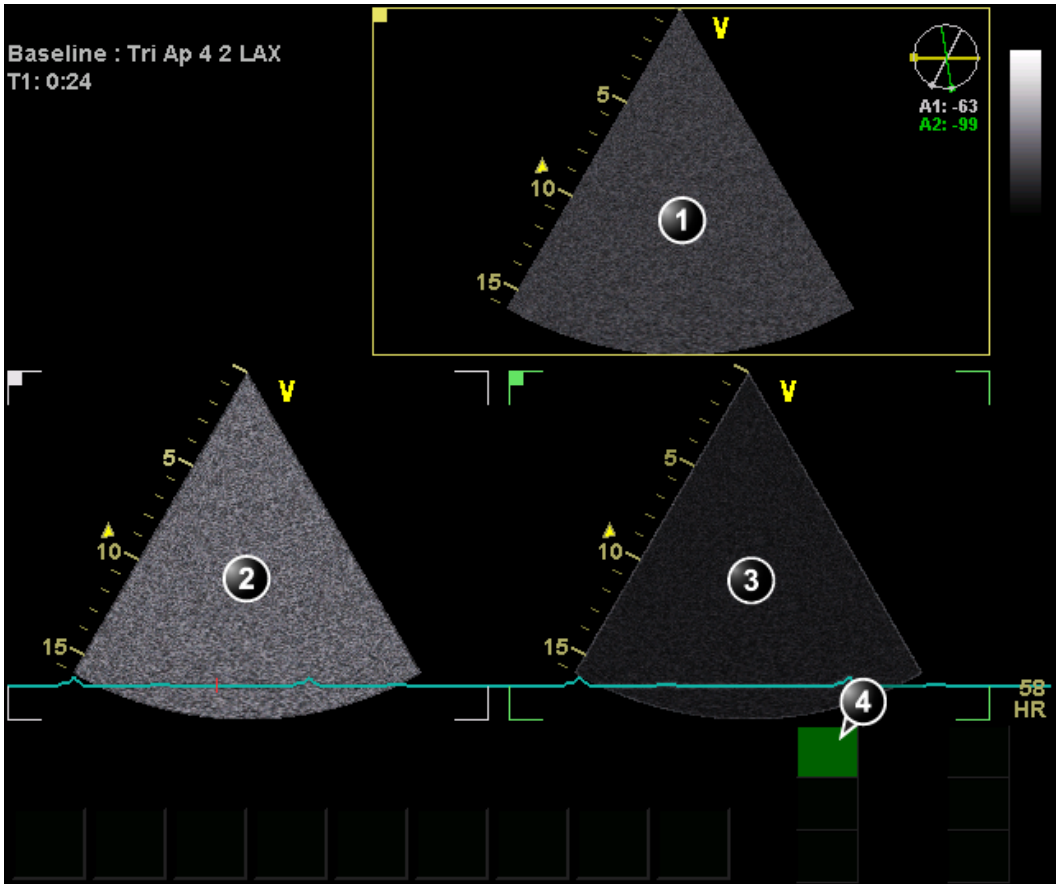
Stress Template setup

1. In the *Grid size field*, adjust the **Number of levels** to three and the **Number of projection views** (columns) to two.
2. From the *Label drop-down menu* of the first column select the label **Tri Ap 4 2 LAX**.
   With this setting the system will automatically launch the Tri-plane mode enabling simultaneous acquisition of Apical 4 chamber, 2 chamber and Long axis views in all levels in the first column.

3. From the *Label drop-down menu* of the second column select the label **Bi PLAX PSAX**.
   With this setting the system will automatically launch the Bi-plane mode enabling simultaneous acquisition of Parasternal long axis and short axis views in all levels in the second column.
4. Enter the labels for the three levels.
5. Make sure that **Smart stress** is checked. This will ensure that all acquisition settings defined at Baseline will be preserved in the next levels, including rotation and tilt angle settings.
6. Delete any existing predefined groups (in case the template is based on an existing template with groups already defined).
7. Select all the views from the first column and select **New group**.
   The *Group name window* is displayed.
   Note: You should not mix bi-plane and tri-plane recordings in the same analysis group.
8. Give the group a name (e.g. Apical) and press **OK**.
9. Likewise create a group for all the views from the second column (e.g. Parasternal).
10. All other settings should be as shown in Figure 5-1.
    Refer to the system User manual for additional information on stress template creation.
11. Select **Save as template** and give the template a name (e.g Pharm. 3x2 Multiplane).
12. Select **OK** in the *Template editor screen*.
    The new template is selected and the *Protocol screen* is displayed.

Stress test acquisition

Baseline acquisitions



1. **Scan plane 1 (yellow): acquire an Apical 4 chamber view.**
2. **Scan plane 2 (white): an Apical 2 chamber view is displayed.**
3. **Scan plane 3 (green): an Apical long axis view is displayed.**
4. **Active cell**

Figure 5-2: The Baseline acquisition screen (Apical acquisition)

1. When in the *Protocol screen* with the Multi-plane stress template selected, press **Begin/Cont** to start the stress test acquisition.
2. The first Baseline view acquisition screen displays a Tri-plane mode. The positions of the scan planes are set so

that the acquisition of an Apical 4 chamber view in scan plane 1(yellow) displays an Apical 2 chamber in scan plane 2 (white) and an Apical long axis in scanplane 3 (green).
If required, fine tune the angle of scan plane 2 and 3 to get optimal views in these scan planes and adjust the image quality.

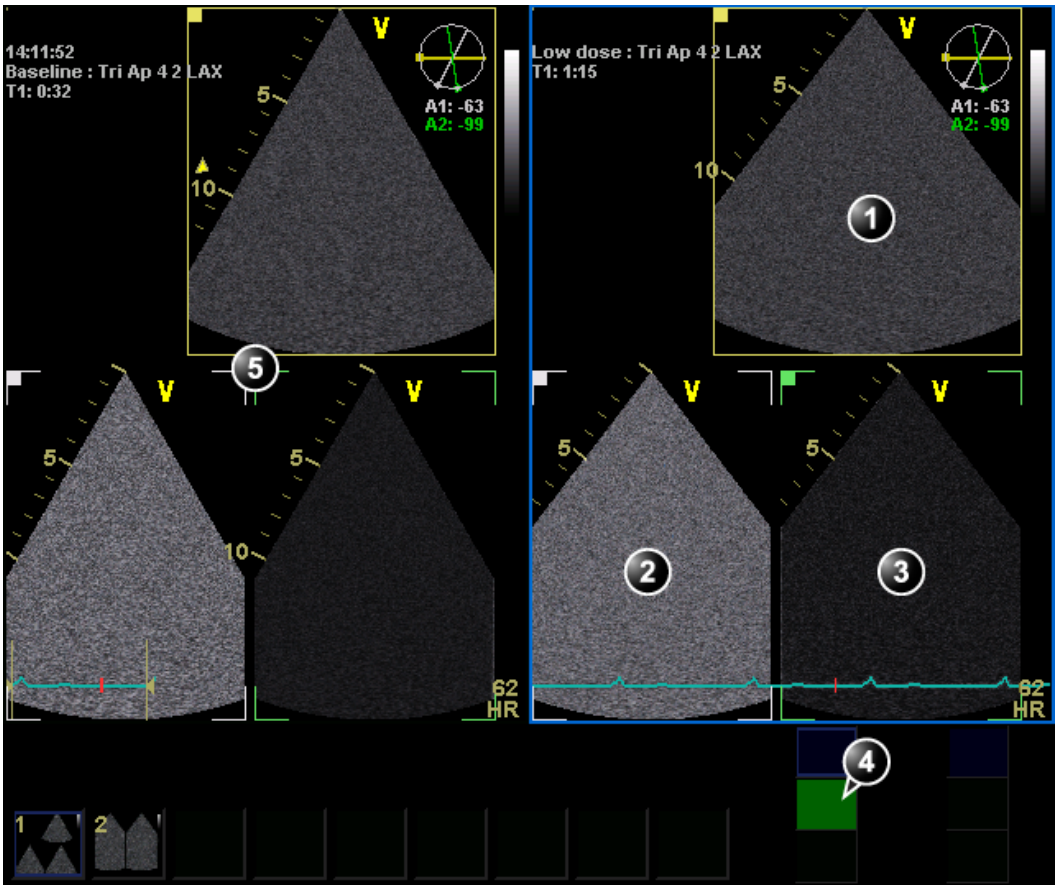
3. Press **IMAGE STORE**.
   This template is set to preview cineloop before storing, use the cineloop controls to select and adjust the most appropriate heart cycle. Press **IMAGE STORE** or **SELECT** to save the cineloop.
4. The second Baseline view acquisition screen displays a Bi-plane mode. The acquisition of a Parasternal long axis view in scan plane 1 (yellow) displays a Parasternal short axis in scan plane 2 (white).
   If required, fine tune the position of scan plane 2 to display a mid short axis view (on level with papillary muscles) and adjust the image quality.

1. **Scan plane 1 (yellow): acquire a Parasternal long axis view.**
2. **Scan plane 2 (white): a Parasternal short axis view is displayed.**
3. **Active cell**

Figure 5-3: The Baseline acquisition screen (Parasternal acquisition)

5. Press **IMAGE STORE**.
   Select and adjust the most appropriate heart cycle. Press **IMAGE STORE** or **SELECT** to save the cineloop.
   The acquisition screen for the first Low dose level view is displayed.

Low dose and Peak dose level acquisitions



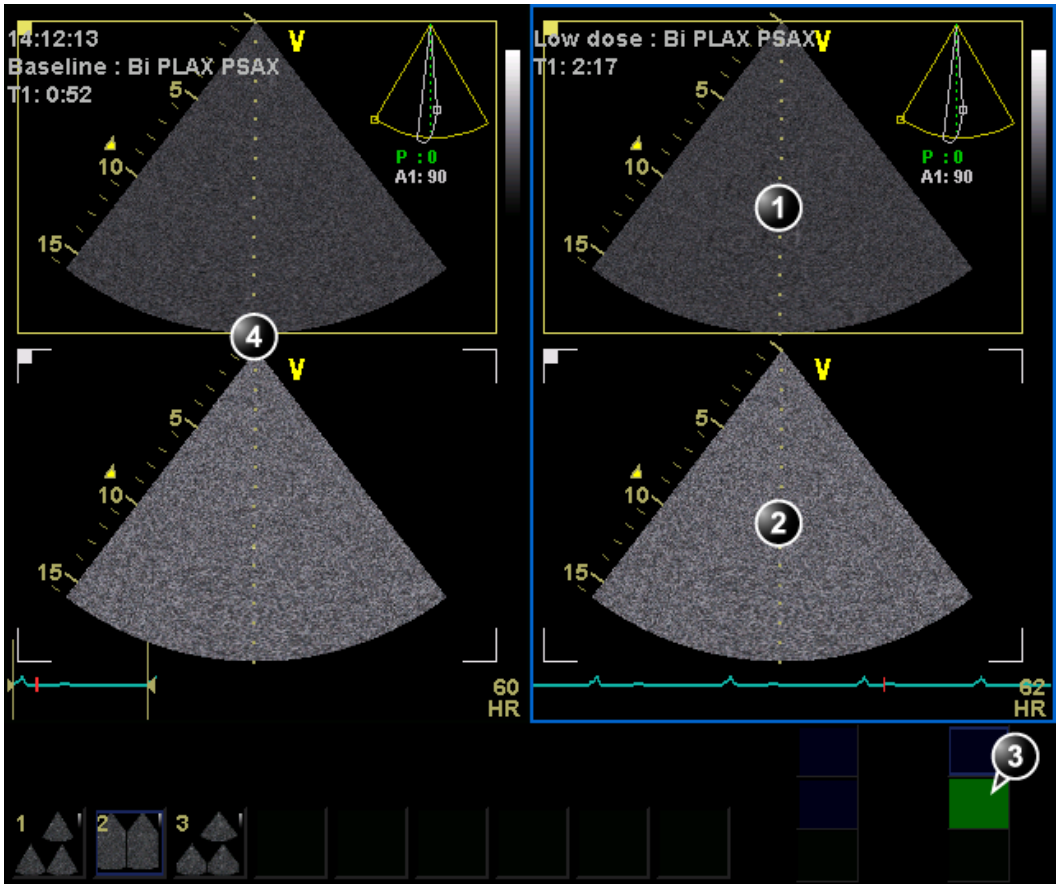
1. **Scan plane 1 (yellow): acquire an Apical 4 chamber view.**
2. **Scan plane 2 (white): an Apical 2 chamber view is displayed.**
3. **Scan plane 3 (green): an Apical long axis view is displayed.**
4. **Active cell**
5. **Baseline acquisition corresponding to the current acquisition.**

Figure 5-4: The Low dose acquisition screen (Apical acquisition)

1. When *Show reference* is enabled in the template, the corresponding Baseline view is displayed on the left side of the screen during Low dose and Peak dose acquisitions. Acquire an Apical 4 chamber view in scan plane 1. The angle and image adjustments done during Baseline

acquisition are automatically set for this acquisition (Smart stress enabled).

2. Press **IMAGE STORE**.
   Select and adjust the most appropriate heart cycle. Press **IMAGE STORE** or **SELECT** to save the cineloop.
   The second Low dose level acquisition view (Bi-plane mode) is displayed with the corresponding Baseline acquisition.



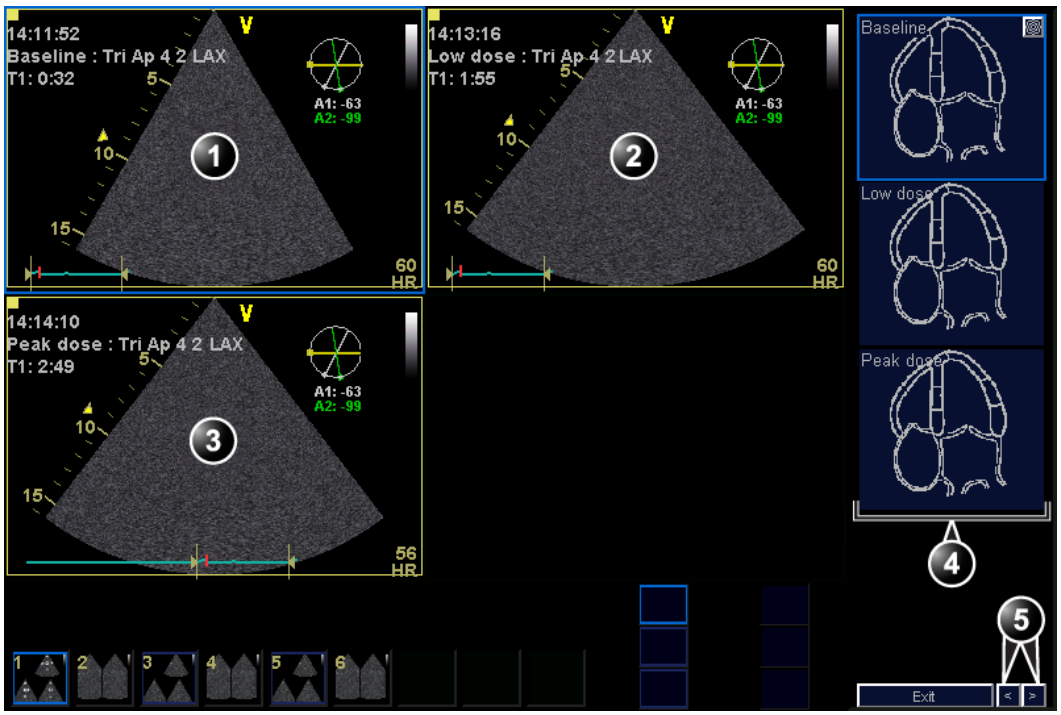
1. **Scan plane 1 (yellow): acquire a Parasternal long axis view.**
2. **Scan plane 2 (white): a Parasternal short axis view is displayed.**
3. **Active cell**
4. **Baseline acquisition corresponding to the current acquisition.**

Figure 5-5: The Low dose acquisition screen (Parasternal acquisition)

3. Acquire a Parasternal long axis view in scan plane 1. The position/angle and image adjustments done during Baseline acquisition are automatically set for this acquisition.
4. Press **IMAGE STORE**.
   Select and adjust the most appropriate heart cycle. Press **IMAGE STORE** or **SELECT** to save the cineloop.
   The acquisition screen for the first Peak dose level acquisition view (Tri-plane mode) and corresponding base line acquisition are displayed.
5. Repeat step 1 to 4 to acquire Peak dose view.
6. The Stress template is set to start analysis automatically. When the last acquisition is stored a dialogue window is displayed asking the user to start analysis. Select **Yes** to start the protocol analysis.

Image analysis

This section describes the basic procedure for image analysis for the current example. Refer to the system User manual for additional information on stress echo image analysis.



1. **Scan plane 1 (yellow): Apical 4 chamber, Baseline**
2. **Scan plane 1 (yellow): Apical 4 chamber, Low dose**
3. **Scan plane 1 (yellow): Apical 4 chamber, Peak dose**
4. **Corresponding Wall segment diagrams**
5. **Previous next images/group**

Figure 5-6: The Stress echo analysis screen (Apical group, 4 chamber acquisition)

1. When starting analysis, the *Stress echo analysis screen* is displayed, showing the first scan plane from the images in the first group (Apical 4 chamber for all three levels, acquired in scan plane 1 (yellow) in Tri-plane mode) and the corresponding wall segment diagrams.
2. Perform segment scoring.

3. Select the **Right arrow** in the lower right corner of the screen to display the next scan planes from the images in the first group (Apical 2 chamber for all three levels, acquired in scan plane 2 (white) in Tri-plane mode).
4. Perform segment scoring.
5. Select the **Right arrow** in the lower right corner of the screen to display the next scan planes from the images in the first group (Apical long axis for all three levels, acquired in scan plane 3 (green) in Tri-plane mode).
6. Perform segment scoring.
7. Select the **Right arrow** in the lower right corner of the screen to display the first scan plane from the images in the second group (Parasternal long axis for all three levels, acquired in scan plane 1 (yellow) in Bi-plane mode).
8. Perform segment scoring.
9. Select the **Right arrow** in the lower right corner of the screen to display the next scan planes from the images in the second group (Parasternal short axis for all three levels, acquired in scan plane 2 (white) in Bi-plane mode).
10. Press **NEW EXAM** or **ARCHIVE** and select **END EXAM**. The examination is stored.

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